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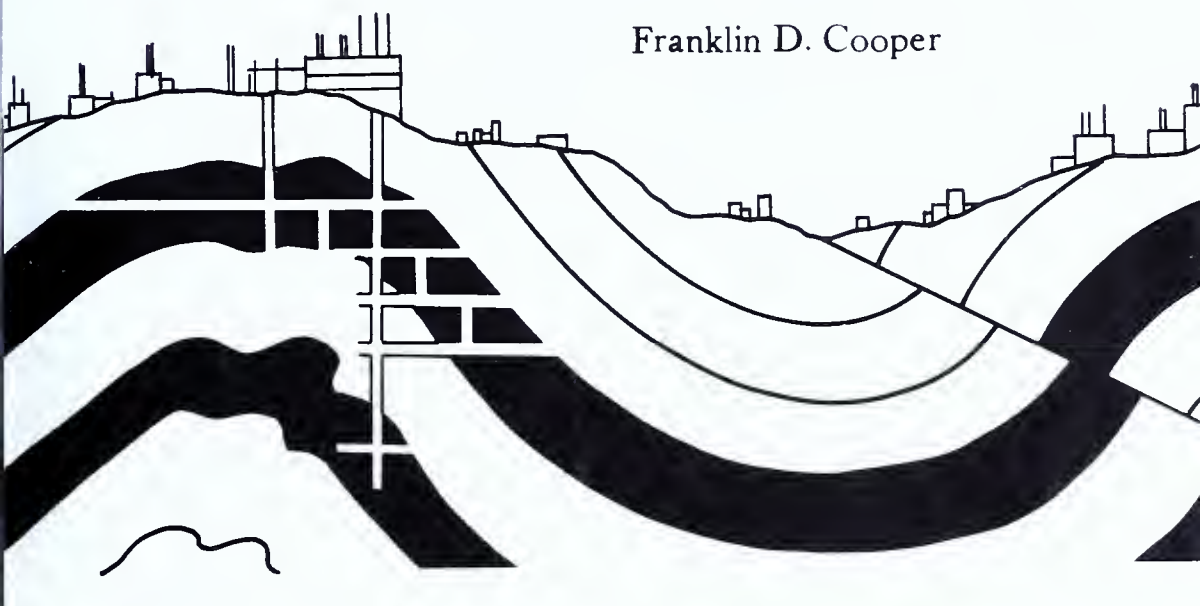
THE MINERAL INDUSTRY OF PENNSYLVANIA IN 1971

Franklin D. Cooper



COMMONWEALTH OF PENNSYLVANIA

DEPARTMENT OF ENVIRONMENTAL RESOURCES

BUREAU OF

TOPOGRAPHIC AND GEOLOGIC SURVEY

Arthur A. Socolow, State Geologist

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The Mineral Industry of Pennsylvania

This chapter has been prepared by the Bureau of Mines, U.S. Department of the Interior, and the Pennsylvania Bureau of Topographic and Geologic Survey, Department of Environmental Resources, under a cooperative agreement for collecting information covering the mineral production from mines, quarries, and wells.

By Franklin D. Cooper [1]

Pennsylvania mineral production reached a record output value of $1,149.1 million, a $53.4 million increase above that of 1970. Compared with 1970, increases in value were attained by cements, bituminous coal, copper, gem stones, lime, and sand and gravel. Output value decreases were noted for anthracite, clays excluding kaolin, natural gas, peat, crude petroleum, stone, and zinc. The value of all natural gas liquids was 16 percent less than in 1970.

Compared with the 1970 figures, the average f.o.b. mine value of anthracite increased $1.03 per ton and that of bituminous coal advanced $1.24 per ton. Collectively, solid-fuels production ac-

[1] Physical scientist, Division of Fossil Fuels.

Table 1.—Mineral production in Pennsylvania [1]

Mineral	1970		1971	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Portland—thousand 376-pound barrels	40,909	$121,100	41,753	$140,460
Masonry—thousand 280-pound barrels	2,804	8,324	2,994	11,247
Clays [2]—thousand short tons	2,665	15,845	2,325	8,940
Coal:				
Anthracite—do	9,729	105,341	8,727	103,469
Bituminous—do	80,491	585,057	72,835	620,196
Copper—short tons	2,539	2,930	3,349	3,483
Gem stones	NA	4	NA	9
Lime—thousand short tons	1,887	29,279	1,760	30,008
Mica, scrap—do	1	60	W	W
Natural gas—million cubic feet	76,841	21,439	76,451	20,770
Natural gas liquids:				
Natural gasoline and cycle products—thousand 42-gallon barrels	19	50	W	W
LP gases—do	34	87	W	W
Peat—thousand short tons	44	517	38	461
Petroleum (crude)—thousand 42-gallon barrels	4,093	18,500	3,798	17,699
Sand and gravel—thousand short tons	18,504	33,915	19,668	36,162
Stone—do	66,241	120,187	64,467	118,469
Zinc (recoverable content of ores, etc.)—short tons	29,554	9,055	27,438	8,835
Value of items that cannot be disclosed: Clays (kaolin), cobalt, gold, iron ore, pyrites, sericite-schist (1970), silver, tripoli and values indicated by symbol W	XX	24,053	XX	28,899
Total	XX	1,095,743	XX	1,149,107
Total 1967 constant dollars	XX	980,142	XX	[p] 998,344

[p] Preliminary. NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes kaolin which is included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Pennsylvania, by county [1]

(Thousands)

County	1970	1971	Minerals produced in 1971 in order of value
Adams	W	W	Stone, lime, clays,
Allegheny	$35,582	$47,246	Coal, cement, sand and gravel, clays, stone.
Armstrong	W	54,037	Coal, sand and gravel, clays, stone.
Beaver	W	W	Sand and gravel, coal, clays.
Bedford	W	W	Stone, sand and gravel, coal.
Berks	W	32,734	Cement, iron ore, stone, clays, sand and gravel, pyrites, cobalt.
Blair	2,110	W	Stone, sand and gravel.
Bradford	W	W	Sand and gravel.
Bucks	W	W	Stone, sand and gravel, clays.
Butler	W	21,022	Coal, cement, stone, lime, sand and gravel.
Cambria	W	W	Coal, clays, stone.
Carbon	5,318	4,304	Coal, sand and gravel, stone.
Centre	23,581	22,025	Lime, coal, stone, clays.
Chester	W	W	Lime, stone, clays.
Clarion	22,723	30,485	Coal, stone, sand and gravel, clays.
Clearfield	34,372	47,923	Coal, clays.
Clinton	W	W	Do.
Columbia	W	3,776	Coal, sand and gravel, stone, peat.
Crawford	740	585	Sand and gravel.
Cumberland	W	W	Stone, sand and gravel, clays.
Dauphin	W	2,145	Stone, coal.
Delaware	W	W	Stone.
Elk	W	W	Coal, stone.
Erie	W	W	Sand and gravel, peat.
Fayette	17,482	16,146	Coal, stone, clays.
Forest	W	312	Sand and gravel.
Franklin	W	W	Stone, sand and gravel.
Fulton	W	W	Stone, sand and gravel, coal.
Greene	102,235	80,060	Coal.
Huntingdon	W	W	Sand and gravel, stone, clays.
Indiana	60,525	73,014	Coal.
Jefferson	W	W	Coal, clays, stone.
Lackawanna	W	W	Coal, peat.
Lancaster	10,499	9,868	Stone, clays, sand and gravel.
Lawrence	W	32,345	Cement, coal, stone, sand and gravel, clays, peat.
Lebanon	W	W	Iron ore, lime, copper, stone, cobalt, pyrites, gold, silver.
Lehigh	32,842	29,111	Cement, zinc, stone.
Luzerne	35,212	37,585	Coal, stone, sand and gravel, peat, clays.
Lycoming	W	W	Stone, sand and gravel, coal, tripoli.
McKean	W	W	Clays, stone.
Mercer	W	W	Coal, sand and gravel, stone.
Mifflin	W	W	Sand and gravel, stone, lime.
Monroe	W	W	Stone, sand and gravel, clays, peat.
Montgomery	W	W	Stone, cement, lime, clays.
Montour	W	W	Stone, lime.
Northampton	63,992	77,694	Cement, stone, sand and gravel.
Northumberland	W	11,372	Coal, stone, clays, sand and gravel.
Perry	W	W	Stone, sand and gravel.
Philadelphia	W	W	
Potter	93	101	Stone.
Schuylkill	W	W	Coal, stone, clays.
Snyder	W	W	Stone.
Somerset	27,348	30,957	Coal, stone, clays, sand and gravel.
Sullivan	964	1,116	Coal.
Susquehanna	606	553	Stone.
Tioga	W	4,376	Coal, sand and gravel.
Union	W	W	Stone, clays.
Venango	W	W	Coal, sand and gravel.
Warren	933	1,115	Sand and gravel.
Washington	W	W	Coal, stone, clays.
Wayne	W	W	Stone, peat, sand and gravel.
Westmoreland	24,375	28,249	Coal, sand and gravel, stone.
Wyoming	W	W	Sand and gravel.
York	W	26,408	Cement, stone, lime, clays, sand and gravel, mica.
Undistributed [2]	594,213	422,445	
Total [3]	1,095,743	1,149,107	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Cameron, Juniata, and Pike Counties are not listed because no production was reported.

[2] Values of natural gas, natural gas liquids, petroleum, gem stones and some stone unspecified by counties, and counties indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

counted for 63 percent of the total mineral production value in both 1970 and 1971.

Although the production of bituminous coal was 9.5 percent less than in 1970 because of a 44-day work stoppage, the value was 6.0 percent greater.

Table 3.—Indicators of Pennsylvania business activity

		1970	1971 p	Change, percent
Employment and labor force, annual average:				
Total labor force	thousands	r 5,041.0	5,035.8	−0.1
Unemployment	percent of work force	4.0	5.2	+30.0
Employment:				
Manufacturing	thousands	r 1,523.4	1,429.7	−6.2
Construction	do	r 195.4	192.7	−1.4
Mining	do	39.6	38.7	−2.3
Transportation and public utilities	do	266.8	263.8	−1.1
Services	do	685.1	698.5	+2.0
Wholesale and retail trade	do	827.9	840.1	+1.5
Government	do	618.7	627.9	+1.5
Finance, insurance, and real estate	do	190.6	194.4	+2.0
Personal income:				
Total	millions	r $46,329	$49,025	+5.8
Per capita		r $3,921	$4,127	+5.2
Construction activity:				
Value of nonresidential construction	millions	r $416.0	$316.8	−23.8
Number of new residential units authorized		r 41,185	54,977	+33.5
Cement shipments to and within Pennsylvania	thousand 376-pound barrels	17,259	18,059	+4.6
Mineral production value	millions	$1,095.7	$1,149.1	+4.9

p Preliminary. r Revised.

Sources: Survey of Current Business, Area Trends in Employment and Unemployment, Construction Review, Employment and Earnings, and U.S. Bureau of Mines.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1970:								
Bituminous coal	22,369	248	5,544	44,661	31	1,208	27.74	5,813
Anthracite	5,938	234	1,392	10,224	5	503	49.69	4,598
Metal	1,351	303	409	3,273	1	20	6.42	2,172
Nonmetal	1,085	252	274	2,213	--	77	34.80	1,880
Sand and gravel	1,131	242	273	2,373	2	80	34.55	8,337
Stone	7,901	275	2,176	18,066	5	273	15.39	2,720
Peat	55	231	13	90	--	4	44.34	3,303
Total [1]	39,830	253	10,081	80,899	44	2,165	27.31	4,785
1971: p								
Bituminous coal	21,100	250	5,260	42,074	32	1,085	26.60	5,873
Anthracite	5,800	239	1,385	10,099	4	450	44.95	3,891
Metal	1,195	315	377	3,014	2	33	11.61	4,896
Nonmetal [2]	1,170	253	297	2,401	--	91	37.90	848
Sand and gravel	1,075	235	252	2,243	--	83	37.00	934
Stone	7,495	277	2,073	17,132	2	280	16.46	1,449
Total [1]	37,810	255	9,644	76,964	40	2,022	26.82	4,289

p Preliminary.
[1] Data may not add to totals shown because of independent rounding.
[2] Beginning in 1971, data concerning peat operations are included in the nonmetals industry.

Leading producing counties, with primary commodities in parentheses, were Washington, Greene, Indiana, Armstrong, and Cambria Counties (bituminous coal), Northampton (cement), and Schuylkill (anthracite). Counties reporting no mineral production were Cameron, Juniata, and Pike.

Pennsylvania led the Nation in production of stone and cobalt; was second in lime, cement, and pyrites; third in coal; and fourth in tripoli.

Legislation and Government Programs.—Major conservation legislation passed in 1971 by the House and Senate during the 1971–72 session of the General Assembly and signed by the Governor included—

H/B 568–Pr. 620.—An amendment to the Bituminous and Anthracite Acts of 1961 that created an Anthracite and Bituminous Coal and Clay Mine Subsidence Fund.

H/B 843–Pr. 1785.—An Act that enabled the Governor to use up to $2 million for emergency mine subsidence relief.

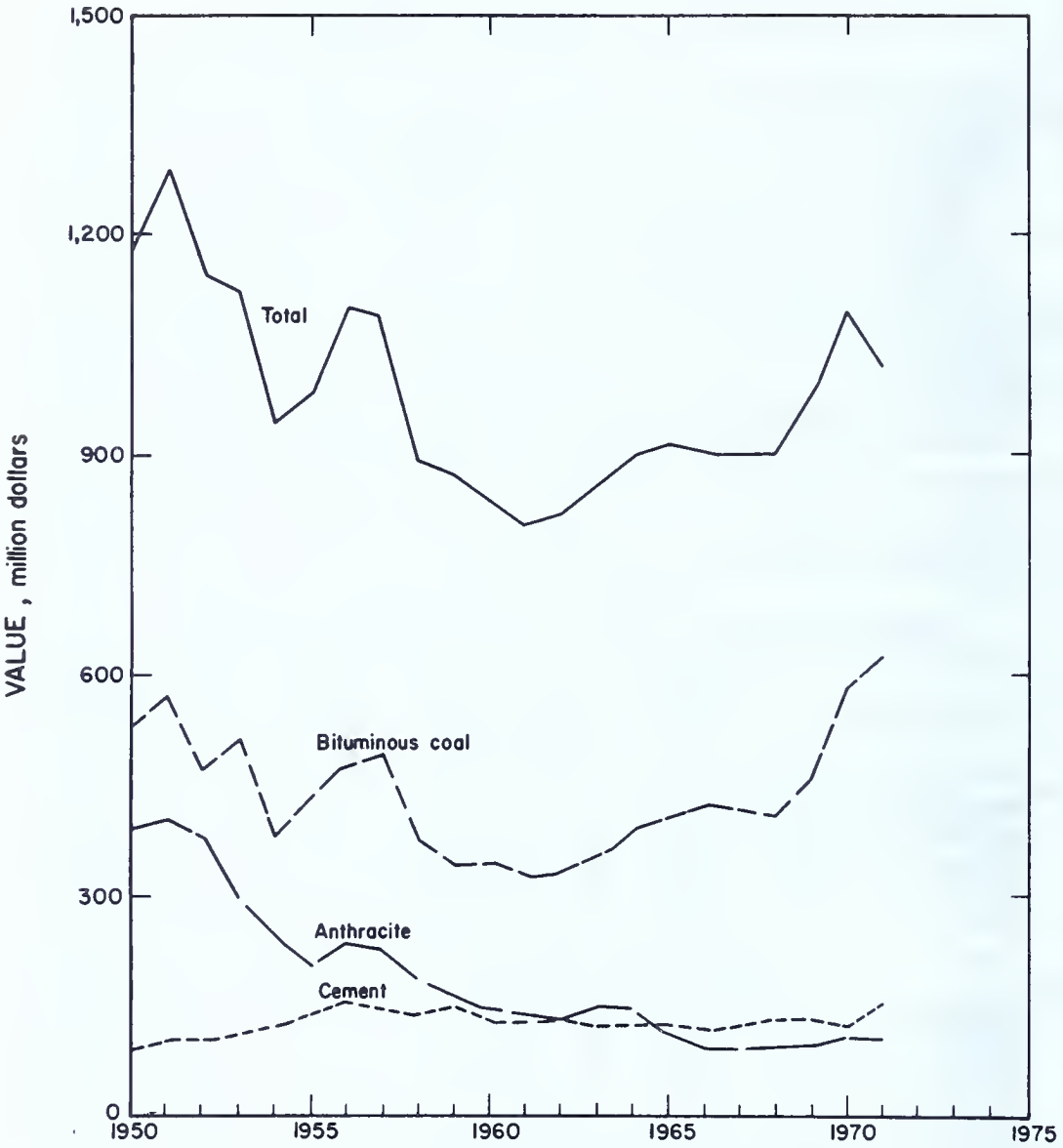

Figure 1.—Value of bituminous coal, anthracite, cement, and total value of mineral production in Pennsylvania.

S/B 135–Pr. 996.—Act 147 of 1971, entitled Surface Mining Conservation and Reclamation Act, was signed into law November 30, 1971, and became effective January 1, 1972. This Act provided for the conservation and improvement of land areas affected by the surface mining of anthracite and bituminous coal, and metallic and nonmetallic minerals. It requires surface mining operators to be licensed and to post bonds assuring compliance, except in the case of quarries expected to be in existence more than 10 years. Before obtaining a mining permit the surface mining operator must file with the Department of Environmental Resources (DER) detailed plans, including maps and other data, showing how the landscape will be restored. Other objectives were to protect wildlife, to enhance land values for taxation, to decrease soil erosion, to prevent pollution of water resources, to reduce hazards to health and safety, to prevent the combustion of unmined coal, and to improve the use and enjoyment of surface-mined lands.

The Environmental Quality Board supplemented Act 147 by regulations that required applicants for all surface mining operations to submit a valid certificate of insurance for a minimum $100,000 total coverage of public liability, personal injury, and property damage. A minimum bond of $5,000 was required for each operation.

On January 19, Pennsylvania under Act 275 took a major step in unifying State environmental programs with the establishment of the Department of Environmental Resources (DER). This one department is responsible for all land and water management programs as well as for environmental control and regulation of mining in the State. The former departments of Mines and Mineral Industries and of Forests and Waters were abolished. The new DER also assumed all the environmental control functions previously conducted by the State Health Department and its two agencies, the Air Pollution Commission and the Sanitary Water Board.

The Bureau of Topographic and Geologic Survey, by a 1970 act, was transferred on January 19, 1971, to the Department of Environmental Resources.

The Bureau of Mines Energy Research Center in Pittsburgh developed a process for the conversion of bituminous coal containing 3.4 weight-percent sulfur into a viscous fuel containing 0.3 weight-percent sulfur, hydrogen sulfide, and an oil for carrying more raw coal to the process. In the process, a mixture of high-sulfur content coal, coal tar, and hydrogen was pressurized and blown with high turbulence through a bed of cobalt molybdate catalyst.

The Lummus Co., a Combustion Engineering Inc. subsidiary, received a contract from the Bureau of Mines to build a $6 million prototype coal-to-gas pilot plant at Bruceton. The 70-ton-per-day unit will demonstrate the Bureau's new Synthane process, which reportedly is capable of processing any type of coal, including those with coking properties; has a high methane yield, which decreases process costs; and has a special catalytic step to boost the heating value of the product gas to more than 900 Btu per cubic foot.

In early November, the Department of the Interior awarded Bituminous Coal Research, Inc. (BCR), a $24.8 million contract to build and operate a pilot plant at Homer City, Pa., for making gas from coal. The contract covered construction costs and 4 years of operation. The Government will pay two-thirds of the cost, and the American Gas Association will pay the rest as part of a continuing joint effort to develop coal gasification processes. BCR subcontracted with The Koppers Co., Inc. for design and engineering work on the plant, based on Government-funded research performed by BCR during the past 5 years. The Homer City plant was expected to become operative in early 1973. The facility will convert 120 tons of coal per day into 2 million to 3 million cubic feet of pipeline-quality gas using the Bi-Gas process, which requires about 1,500 pounds per square inch pressure and a temperature of about 2,500°F.

The first grant under an Environmental Protection Agency (EPA) program was made on June 17, 1971, for a $676,000 project on the Tioga River. The project will demonstrate the effects of varying amounts of agricultural limestone and digested primary and secondary sewage sludges as soil conditioners on restoration work at strip pits; stream channel reconstruction and lining; and restoration and grading of subsidence areas.

A 3-year demonstration project was started by Africa Engineering Associates, Inc., to clean up acid mine drainage by the installation of limestone barriers at six locations in Trough Creek near Huntingdon. The State DER provided funds to build the barriers. Additional funds for the 3-year monitoring of results were supplied by EPA.

The Applied Science Laboratories, at State College, Pa., investigated the partial freezing method to purify acid mine water. The study, made for EPA, attained an 85- to 90-percent reduction of acid and mineral components.

Full-scale field operations were initiated in July 1971 for a study of the water resources of the Clarion River and Redbank Creek drainage basins. This study was a cooperative project by the State Bureau of Topographic and Geologic Survey and the Bureau of Engineering and the U.S. Geological Survey.

Resource Control, Inc., New Haven, Conn., a producer of pollution control equipment, was awarded a $119,473 con-

tract for a demonstration project in the Wilkes-Barre area to remove metallic pollutants from coal mine drainage water. The total cost of the project, which uses an electrochemical process, will be $140,576. The DER will contribute part of the funds and EPA the remainder.

Pennsylvania State University operated an experimental 500,000-gallon-per-day acid mine water treatment plant to evaluate performance and costs. The water was treated in the presence of iron-oxidizing bacteria. The project, at Hollywood, was co-sponsored by EPA.

Under a $223,105 Bureau of Mines grant, employees of the Central Pennsylvania Coal Producers' Association, in October, started a new training program featuring formal instruction in the safe handling of standard mining machinery. The program was presented in an aboveground facility, built to simulate an underground coal mine, on the property of the Florence Mining Co. at Seward.

Because the release of phenolics by coke plants into streams and rivers is a major pollution problem, The University of Pennsylvania, on a $215,000 grant from the National Science Foundation, began an investigation of an enzyme group called polyphenolic oxidases. These enzymes reportedly permit the elimination of phenolic-type pollutants by catalytically converting phenolics into harmless, biodegradable compounds.

A Federal-State project to measure the level and acidity of water in abandoned anthracite mines was approved by the Department of the Interior. Contracts to build and equip the monitoring stations were awarded as sites were approved.

The Pennsylvania State University completed an 18-month study designed to help economists identify effective means for minimizing total costs in dealing with subsidence. The study was funded by a $14,837 grant awarded by the Bureau of Mines in early 1970.

In October, the U.S. Army Corps of Engineers began a 6-month survey to map and locate all waste discharges into the Allegheny, Monongahela, and Ohio Rivers. The aerial survey technique employed was developed by Grumman Eco-Systems. The survey represented phase 2 of a program which required that all wastes could be discharged only after receipt of a Federal permit under the 1899 Waste Refuse Act.

Pennsylvania was one of four charter members of the newly organized Interstate Mining Compact Commission when it formally came into existence at a meeting in Raleigh, N.C., on April 27, 1971. The objective of the Commission was to coordinate and exchange surface mining information among the States.

On April 29, the DER dedicated the Smith Township mine drainage treatment plant near Burgettstown, Washington County. The plant will augment the Smith Township Water Authority's nearby Dinsmore reservoir by providing as much as 500,000 gallons per day. The plant was the Nation's first municipal water installation to use the ion-exchange method for the demineralization of acid mine drainage to produce potable water. Full-scale operation began in late January.

In 1971, the Swindell-Dressler Co. was constructing an ion-exchange plant near Philipburg in Clearfield County for the DER to convert 500,000 gallons per day of mine water into potable water.

Five contracts totaling $4,328,775 of conservation bond issue funds were approved by the DER in 1971 for Operation Scarlift mine area restoration projects. The largest contract was for the Altoona mine drainage treatment plant that will add 5 million gallons per day of water to Altoona's water supply. Two contracts specified the use of fly ash to fill abandoned mine voids to provide surface stabilization in Allegheny County, and a similar project was awarded in West Mifflin Borough. The fifth contract was to control and extinguish a subsurface mine fire in West Mifflin by pumping fly ash slurry through 60 boreholes.

The following Operation Scarlift projects were completed in 1971:

	Projects	Actual cost, dollars
Stream pollution abatement:		
Anthracite	4	$828,923
Bituminous	10	2,424,484
Underground mine fires:		
Anthracite	1	45,991
Bituminous	2	107,624
Mine subsidence:		
Bituminous	3	59,080
Total:		
Anthracite	5	874,914
Bituminous	15	2,591,188

In May 1971, the State canceled a contract awarded in 1970 to the Westinghouse Electric Corp. to build a $5.5 million plant to treat acid mine water near Buttonwood in the Wilkes-Barre area.

The DER received bids on December 16 for four projects to eliminate acid mine drainage from the Shaw mine-complex in Somerset County. The projects included strip mine backfilling, sealing deep mines with concrete and clay, filling underground voids with dry fly ash, and grading, contouring, and planting the entire area.

The Bureau of Mines Liaison Office for Pennsylvania was established in Harrisburg, on October 3, 1971.

Pursuant to the Appalachian Regional Development Act of 1965, as amended, mining area restoration projects completed or in progress during 1971 and their final cost or estimated value of contracts in force included 11 mine-fire control projects; two of these were completed in two counties at a cost of $181,340, while nine projects, costing $8,610,448, were in progress in six counties. One subsidence control project costing $1,480,055 was also completed. All of these projects had 75 percent Federal funding and 25 percent State funding. No surface mine or well-sealing projects were completed or in progress; however, two well-sealing projects and one subsidence project were approved by the Appalachian Regional Commission for a total Federal-State expenditure of $1,868,000. Work funded equally by Federal and State Governments was in progress under Public Law 162 on mine-water-monitoring stations, all in the anthracite region, at a total cost of $120,241.

Eleven Bureau of Mines publications released in 1971 discuss problems relating to the mineral industry of Pennsylvania.[2] The U.S. Geological survey issued five publications concerning Pennsylvania,[3] and there were four Pennsylvania Geological Survey releases[4] and five miscellaneous releases.[5]

The total cost of projects underway or authorized for the Interstate highway system in Pennsylvania in 1971 totaled $835.8 million, $55.7 million more than in 1970, while projects for primary, secondary, and urban highway extensions totaled $461.4 million, $59.3 million more than in 1970. The total cost of Interstate highway projects completed in 1971 was $59.9 million, while the total cost of primary, secondary, and urban highway extensions completed was $48.6 million. Interstate highway mileage opened to traffic since July 1, 1956 increased 22.75 miles to 1,384.08 miles; at

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[2] Cochran, William. Mine Subsidence—Extent and Cost of Control in a Selected Area. BuMines IC 8507, 1971, 32 pp.

Dierks, H. A., R. H. Whaite, and A. H. Harvey. Three Mine Fire Control Projects in Northeastern Pennsylvania. BuMines IC 8524, 1971, 53 pp.

Eckerd, James W., and John D. Spencer. Anthracite Preparation—Past and Present. Presented at 100th Ann. Meeting, AIME, New York, Mar. 1–4, 1971, AIME Preprint 71–F–57, 9 pp.

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McNay, Lewis M. Coal Refuse Fires, An Environmental Hazard. BuMines IC 8515, 1971, 50 pp.

Raufaste, Noel J., Jr. An Attitudinal Survey of Area Residents Toward Indiscriminate Trash Dumping and Possible Causes of Anthracite Mine Fires. Pennsylvania Anthracite Region. Volume 1: Analysis. Prepared for BuMines by Resource Management Corp., December 1970, 59 pp. (OFR 7–71).

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Sawyer, W. K., C. I. Pierce, and R. B. Lowe. Electrical and Hydraulic Flow Properties of Appalachian Petroleum Reservoir Rocks. BuMines RI 7519, 1971, 22 pp.

Sheffer, H. W., E. C. Baker, and G. C. Evans. Case Studies of Municipal Waste Disposal Systems. BuMines IC 8498, 1971, 36 pp.

U.S. Bureau of Mines. Strippable Reserves of Bituminous Coal and Lignite in the United States. IC 8531, 1971, 148 pp. (For Pennsylvania data, see pp. 47–48, 141–142.)

[3] Berryhill, H. L., Jr., S. P. Schweinfurth, and B. H. Kent. Coal-Bearing Upper Pennsylvanian and Lower Permian Rocks, Washington Area, Pennsylvania. U.S. Geol. Survey Prof. Paper 621, 1971, 47 pp.

Growitz, D. J., and O. B. Lloyd, Jr. Relationship Between Ground-Water Levels and Quality in Shallow Observation Wells, Muddy Creek Basin, Southeastern York County, Pennsylvania. U.S. Geol. Survey Prof. Paper 750–D, 1971, pp. D178–D181.

Patterson, E. D., and J. A. Van Lieu. Coal Resources of Butler County, Pa. U.S. Geol. Survey Bull. 1143–C, 1971, pp. C1–C43.

Reed, L. A. Hydrology and Sedimentation of Corey Creek and Elk Run Basins, North-Central Pennsylvania. U.S. Geol. Survey Water Supply Paper 1532–E, 1971, pp. E1–E27.

Roen, J. B. Preliminary Geologic Map of the Midway Quadrangle, Southwestern Pennsylvania. U.S. Geol. Survey Misc. Field Studies Map MF–319, December 1971.

[4] Glass, Gary B. Computer Program for Coal Analyses. Pennsylvania Geology (Pennsylvania Geological Survey), v. 2, No. 2, April 1971, pp. 7–9.

yearend, 77.05 miles was under construction and 79.98 miles was in the design stage.[6]

The Pennsylvania Department of Transportation (Penn DOT) in calendar year 1971 awarded contracts for highway construction in the amount of $225.6 million. Contract expenditures by the State in 1971 for highway construction totaled $389.6 million and was distributed as follows: Interstate, $109.7 million; primary, $44.6 million; secondary, $28.1 million; urban, $41.7 million; Appalachian, $21.5 million; and "100 percent State," $144.0 million. The total expenditure for highway construction was $27.4 million less than in 1970. As of January 1972, Penn DOT had 374 active construction contracts with a total value of $1,279,534. In January 1971 there were 522 active construction contracts with a total value of $1,533,181. As of January 1972, the State Highway system totaled 44,237 miles, while the total of all public roads in the Commonwealth (State system, roads and streets under the jurisdiction of cities, boroughs and townships, and State Park and U.S. National Forests roads) totaled 115,259 miles. The State Highway system increased 140 miles during 1971.

In 1971, the Pennsylvania Industrial Development Authority gave tentative approval for five loan projects and final approval for 10 loan projects, all of which were directed to manufacture products, of mineral origin. Five of the projects in four counties had loans and commitments totaling $5,142,800, and will produce refractory coatings, fiberglass for reinforced plastics, glass for automobiles, concrete blocks, and slag breakers. Nine other projects in seven counties had total loans and commitments equaling $2,771,300, and their principal products will be steel mill machinery, steel products and fasteners, specialty valves, and titanium wire.

Environment.—*Air Pollution.*—The Allegheny County Bureau of Air Pollution Control was developing a computerized air monitoring system. In 1971, the automatic telemetering network comprised a central station and seven remote monitoring stations having a total of 53 sensors. Five of the stations were located in river valleys where the major industrial sources of air pollution were located.

The Allegheny Bureau of Air Pollution Control's emission inventory for 1971 distributed pollutants as follows:

Source	Total weight (tons)	Percent of total weight
Mobile sources	1,220,219	72.0
Power generation	284,953	16.8
Industrial processes	163,249	9.6
Domestic and commerical heating	22,643	1.3
Solid waste incineration	4,317	.3
Total	1,695,381	100.0

The Allegheny County Bureau of Air Pollution Control received and evaluated 525 permit applications. Of the total, 12 applied to metallurgical equipment comprising six annealing and forging furnaces and six electric, induction, and open hearth furnaces.

In Allegheny County, the operation of single-chamber incinerators was prohibited after July 1971. Prior to this date, such incinerators annually discharged into the atmosphere approximately 1,200 tons of particulates, 1,200 tons of carbon monoxide, and 900 tons of hydrocarbons.

Hoover, K. V. Directory of the Mineral Industry in Pennsylvania. Pennsylvania Bureau of Publications, Bull. IC–54, 2d ed., 1971, 132 pp., 1 map.

Pennsylvania Geological Survey. Industrial Minerals Produced in Pennsylvania, 1971. Map No. 27, 1 p.

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[5] Bituminous Coal Research, Inc. Studies on Densification of Coal Mine Drainage Sludge. A Description of Research Conducted by Bituminous Coal Research, Inc., with the Cosponsorship of the Environmental Protection Agency and the Pennsylvania Department of Environmental Resources. September 1971, 113 pp.; report available from the National Coal Association, Washington, D.C.

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Maneval, David R. Pennsylvania Cleans Up Its Anthracite Fields. Min. Eng., v. 23, No. 6, June 1971, pp. 57–60.

Slater, George E. Importance of Underground Gas Storage in Pennsylvania. Earth and Mineral Sciences (Pennsylvania State University), v. 40, No. 8, May 1971, pp. 57–60, 63.

[6] Federal Highway Administration. Quarterly Reports on the Federal-Aid Highway Program, Dec. 31, 1970 and Dec. 31, 1971. Press Release FHWA–563, Feb. 17, 1971; FHWA–29–72, Mar. 6, 1972.

In Philadelphia County, fuels were limited in percent of sulfur content as shown:

No. 2 and lighter oils	0.3
No. 4 oil	.7
No. 5 and No. 6 oils	1.0
Bituminous coal, Jan. 1–June 30, 1971	2.0
Bituminous coal, July 1–Dec. 31, 1971	1.0
Anthracite	.7

The combustion of noncommercial fuels such as coke-oven and petroleum refinery gases was limited to 640 parts per million (by volume) sulfur dioxide content adjusted to 12 volume-percent carbon dioxide in the stack emissions. Processes other than combustion were limited to 1,000 parts per million (by volume) sulfur dioxide in stack emissions.

In 1971, the Bureau of Air Quality and Noise Control of DER, did not limit the sulfur content of fuels or the quantity of sulfur dioxide released during their combustion in the 65 counties supervised by the Bureau. Table 5 summarizes the extent and cost of air pollution abatement in Pennsylvania in 1971.

Water Pollution.—Jones & Laughlin Steel Corp., at its Vesta No. 5 mine, on April 23, was confronted with having 150,000 gallons per day of clean water, discharged from a borehole during the past 17 years, abruptly turn acidic and bright red. A pollution control system costing $30,000 was put into operation by May 1. The system included the construction of a 6-acre lake and the installation of 4,000 feet of plastic pipe to carry decanted water from the lake to an existing neutralization plant.

As a result of underground coal mining by the Barnes and Tucker Co., near Ebensburg, 36 homes in the Barr and

Table 5.—Air pollution abatement compliances

Industry and county	Number of process compliances	Emission reduction [1] (tons per year)	Estimated cost of equipment and controls	
			Thousands	Dollar per-ton emission-reduction per year
Ferrous metals:				
Allegheny	4	107	$60	$561
Philadelphia	--	--	--	--
All other [2]	10	9,319	2,200	236
Total	14	[3] 9,426	2,260	240
Nonferrous metals:				
Allegheny	--	--	--	--
Philadelphia	2	450	500	1,111
All other [2]	1	18	40	2,222
Total	3	[3] 468	540	1,154
Nonmetallics: [4]				
Allegheny	17	510	945	1,853
Philadelphia	3	602	540	897
All other [2]	24	17,158	559	33
Total	44	[3] 18,270	2,044	112
Coal and petroleum:				
Allegheny	2	[5] 25,975	9,818	378
Philadelphia	3	[6] 4,096	9,400	2,295
All other [2]	10	[3] 8,067	2,506	311
Total	15	38,138	21,724	570
Total:				
Allegheny	23	26,592	10,823	407
Philadelphia	8	5,148	10,440	2,028
All other [2]	45	34,562	5,305	163
Grand total	76	66,302	26,568	401

[1] Rated design capacity applicable to varied numbers of operating days per year.
[2] Sixty-five counties controlled by the Pennsylvania Department of Environmental Resources, Bureau of Air Quality and Noise Control.
[3] Principally particulates.
[4] Rock products, plantmix asphalt, glass, enamel, and fertilizer plants.
[5] Particulates and sulfur dioxide.
[6] Comprises 365 tons of particulates, 1,260 tons of sulfur dioxide, and 2,471 tons of hydrocarbons.

Blacklick Townships lost their supply of well water. The company agreed to pay $66,000 toward the cost of a new plant to treat water from deep mines in the area. The treated water was piped to the homes through a system built by the two townships.

In April, the Commonwealth Court in Harrisburg ordered the Barnes and Tucker Co. to resume operation of a $350,000 acid mine water treatment plant at its Lancashire No. 15 mine and to share the costs with the State until a final verdict was rendered. At issue was the question whether or not the owner of an abandoned coal mine was responsible for water pollution that occurred after the mine had been abandoned. The treatment plant used lime to neutralize 7 million gallons per day of acidic water from the firm's Lancashire No. 15 mine that was shutdown in 1969.

The Industry-Conservation Council in Pittsburgh sought Federal help on a proposed project to treat 20 million gallons per day of acid mine water in a $6 million reverse-osmosis plant. The water source would be a 100-billion-gallon pool in a 42-square-mile underground mine-complex in Westmoreland County. Reportedly, the Army Corps of Engineers could handle the project and was enthusiastic about it. The State's participation depended largely on whether the project would significantly reduce stream pollution in the area. The treated water would be suitable for domestic and industrial uses.

Solid Wastes.—The Franklin Institute in Philadelphia converted incinerator refuse into slag, which was crushed for use as highway aggregate. Although the product was not competitive economically with conventional materials, it may become so as landfilling of incinerator refuse becomes more expensive and deposits of natural aggregate are exhausted.

The Pennsylvania Joint Legislative Air and Water Pollution Control and Conservation Committee studied the abandoned auto problem in an effort to develop an efficient and practical recycling program.

The State Department of Health gave technical assistance to the Pennsylvania State University field study to determine possible subsurface water pollution caused by sanitary landfills in limestone areas. The University of Pennsylvania was determining the feasibility of grinding solid waste materials and transporting them with water through a pipeline. The Franklin Institute in Philadelphia was experimenting with a solid waste shredding process.

The Warner Co. of Philadelphia had a landfill project, in Bucks County, which eventually will be used as a ski resort. Alternate layers of sand and refuse were compacted until the desired height was reached. The ski slope will shield a residential development tract from a presently visible steel mill.

The Westinghouse Research and Development Center, at Pittsburgh, installed a test section of road, which in its first 12 months had an excellent performance record. The road construction material contained 5 percent compacted household refuse in addition to asphalt, sand, and crushed stone. Reportedly, the road material was as durable as asphalt and more resistant to cracking.

Strip Mine Reclamation.—Responsibility for the control of coal refuse disposal was transferred to the DER's Division of Solid Waste Management late in 1971. The coordination of the review of permit applications, to assure compliance with the Commonwealth's Clean Streams, Air Pollution Control, and Coal Refuse Disposal Act, became a function of the solid waste program. In calendar year 1971, the Division issued 381 bituminous and 69 anthracite licenses, 351 mine drainage permits, and 863 strip mining permits. Bonds totaling $8.3 million applied to 15,000 acres bonded while bonds released totaled $4,428,000. The Division reported acreage mined as 12,000 bituminous and 350 anthracite.

In 1971, according to a State Forest spokesman, bituminous coal strip mine operators restored 17,200 acres, of which at least three-fourths were contour graded. Seven million trees were planted on 7,069 acres on which no fertilizer was applied. Grass was planted on 3,190 acres to which, based on soil tests by the State, an average of 200 pounds per acre of 5–20–20 fertilizer and 2 tons of ground limestone were applied to insure a fair stand of grass.

In the anthracite-producing region strip mine operators restored 411 acres on which 528,090 trees were planted. No fertilizer was used. An 80- to 85-percent survival was

considered good. About 100 square feet were planted with grass on a trial basis.

A "thinning cut" in a 9-year-old planting of hybrid poplar on reclaimed spoil banks of the Hoffman Coal Co., of Karthaus, provided about 11 cords of pulpwood worth about $40 per acre.

To reclaim strip mined land, some of Pittsburgh's garbage and trash was compacted by a process developed by the Aloe Coal Co. and the Swindell-Dressler Engineering Co. and trucked about 18 miles to a clay-lined portion of Aloe's coal stripping operation near the Pittsburgh airport. The city's contract for this means of solid waste disposal cost $1.1 million annually, or $6.85 per ton compared with a cost of $25 per ton at an old incinerator.

A 9-year project was started to level and plant 1,200 acres on the Secham Limestone Industry property near Portersville. Developers of the Lake Arthur Estates planned to use 285 acres of the reclaimed area for a mobile home court.

The National Science Foundation granted funds to six Pennsylvania State University undergraduates for an unprecedented study of the effectiveness of strip mine contour backfilling in the Clarion and Kittanning coalfields. The study included mapping, moisture retention, vegetation, and wildlife populations of recently backfilled areas and a comparison with areas backfilled 30 or more years earlier.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Anthracite).—The 8,727,000 short tons produced was 10.3 percent less than in 1970 and was the smallest in nine consecutive years. However, its $103,469,000 value was only 1.7 percent less than the 1970 value because of an increase in average value of $1.03 to $11.86 per ton.

Commercial exports, principally to Canada and Western Europe, totaled 671,000 tons, 118,499 tons less than in 1970, and were valued at $10,104,000. Exports of anthracite through Philadelphia totaled 440,619 tons. The Federal Government continued purchasing anthracite to supply most of the solid-fuel needs of the U.S. Armed Forces in West Germany. Such shipments in 1971 totaled 718,000 tons compared with 692,000 tons in 1970.

The U.S. consumption in thousand tons was as follows: Residential and commercial heating 3,850; electric utilities 1,646; industrial and miscellaneous uses 1,037; coke plants 451; sintering and pelletizing 339; and colliery fuel 15.

Production originated from 155 underground mines having 1,555 employees, 180 strip mines having 2,229 employees, 81 culm banks having 441 employees, and eight dredges employing an unknown number of employees. Production and value by county are shown in table 6. Schuylkill, Luzerne, and Northumberland Counties accounted for 82 percent of the total State production.

Production, excluding that from dredging operations, totaled 8,337,000 tons and was processed by 103 breakers and washer-

Table 6.—Anthracite production and value, by county

County	Production (thousand short tons)				Total value (thousands)
	Underground	Strip	Bank	Total[1]	
Carbon	14	191	108	313	$3,535
Columbia	20	195	18	233	3,250
Dauphin	53	(2)	21	74	781
Lackawanna	(2)	319	[3] 122	[3] 441	5,889
Luzerne	391	1,598	629	2,618	34,219
Northumberland	160	441	316	917	10,264
Schuylkill	649	1,612	1,355	3,615	41,682
Sullivan	--	122	4	126	1,116
Total	1,287	4,478	2,573	8,337	100,736
Dredged production, total [4]	--	--	--	390	2,733
Grand total	1,287	4,478	2,573	8,727	103,469

[1] Data may not add to totals shown because of independent rounding.
[2] Less than 1 unit.
[3] For Lackawanna and Susquehanna Counties.
[4] For Berks, Dauphin, Lancaster, Northumberland, and Snyder Counties.

ies employing 1,591 persons. Nearly all of the washing and cleaning was performed using dense-medium vessels, cyclones, and Wemco-type cones. The average value of this production was $12.08 per ton. Dredging operations produced 390,000 tons having an average value of $7.01 per ton.

Of the total salable production, 3,739,000 tons valued at $12.30 per ton, was shipped by railroad and 4,973,000 tons valued at $11.92 per ton was shipped by truck. Colliery fuel totaled 15,000 tons and was valued at $14.59 per ton.

Underground mine production was 26 percent less than in 1970 and equaled less than 15 percent of the State's total production. No significant changes were made in mining practices.

Run-of-mine material containing 670,000 tons of salable product and equaling 52 percent of the total underground production was mechanically loaded. Underground loading on the basis of tons of contained salable product comprised 319,000 tons by 95 scraper loaders, 151,000 tons by 18 mobile loaders, and 200,000 tons by a total of 91 duckbills and other self-loading conveyors, and pit-car loaders.

Underground mining consumed 763,250 pounds of permissible explosives and 88,512 pounds of dynamites. Two fatalities and 289 nonfatal accidents occurred at underground anthracite mines.

Reportedly, the State spent $120,000 for electricity to power six pumps that removed approximately 43 million gallons per day of acidic water from the former Delaware colliery shaft. The water was discharged into Mill Creek, a tributary of the Susquehanna River. On exposure to the air the water developed a red-ochre tint. The State took over the pumping operations through default of the former mine operators.

Strip mining and culm bank operations collectively used 61 power shovels, of which 43 were diesel-powered and 18 were electric-powered; 122 draglines, of which 86 were diesel-powered and 36 were electric-powered; 77 front-end loaders; and an unknown number of haulage trucks, scraper loaders, and bulldozers. Strip mining consumed 23,413,432 pounds of permissible explosives and 16,148,387 pounds of dynamites. Strip mining resulted in 189 nonfatal accidents.

Anthracite productivity data for 1971 as well as for 1969 and 1970 are compared in table 7.

According to an official of the United Gas Improvement Corp., of Kingston, no construction was started in 1971 on a proposed 300-megawatt steam-electric plant in the Northern anthracite field. The construction delay was caused by legal difficulties in acquiring title to the site because the subsurface rights were owned by 2,200 individuals. Should the title problem be resolved soon, the plant could be operable by January 1977. Future plans include the construction of a 300-megawatt plant in the Southern anthracite field. The plants will be fueled with upgraded culm bank material burned in Ignifluid combustor furnaces.

In early January a $4.5 million contract was awarded to the Dixon Construction Co., Inc., of Mount Carmel, to extinguish a culm bank fire near Forrestville in Schuylkill County. State officials mysteriously ordered a "hold" payment on the contract in September, and on October 7 the contractor sued the State for $1 million.

The DER warned operators to eliminate air pollution from silt basins or face the loss of mining permits. The pollution was caused by extremely fine silt from washeries and plants that cleaned and prepared small sizes of anthracite. The air pollution was particularly noted in the Shenandoah-Mahanoy City area in Schuylkill County.

Bituminous Coal.—New coal mines that started operation in the State in 1971 eventually will produce 1.95 million tons per year.

The development of the No. 1 and No. 2 underground mines by Greenwich Collieries Co., a subsidiary of the Pennsylvania Power & Light Co., north of Barnesboro in Cambria County, will eventually produce 4 to 5 million tons annually, using continuous miners to block out areas for longwall production from the 42-inch B and D seams. The maximum production is based on a 2-1/2-shift basis during a projected 30-year period. The coal preparation facilities include two 54-inch feed belts, one from each mine; a screening house; cleaning equipment including jigs, sieve bends to obtain separation at 28 mesh, centrifuges, and cyclones; an overland belt conveyor; a radial stacker; and unit train

Table 7.—Anthracite productivity data, 1969–71

Activity	Production (short tons)			Man-days [1]			Productivity (tons per man-day)[1]			Percent change in 1969–71 period
	1969	1970	1971	1969	1970	1971	1969	1970	1971	
Deep mined:										
Extraction	2,150,664	1,666,694	1,245,326	435,091	452,660	304,298	4.94	3.68	4.09	−17.2
Preparation	2,139,994	1,658,809	1,245,326	88,783	66,658	55,437	24.10	24.89	22.46	−6.8
Total or average	2,150,664	1,666,694	1,245,326	523,874	519,318	359,735	4.11	3.21	3.46	−15.8
Strip mined:										
Extraction	4,696,123	4,624,610	4,450,457	466,756	515,182	531,960	10.06	8.98	8.37	−16.8
Preparation	4,696,123	4,624,610	4,450,457	194,832	185,837	198,119	24.10	24.89	22.46	−6.8
Total or average	4,696,123	4,624,610	4,450,457	661,588	701,019	730,079	7.10	6.60	6.10	−14.1
Culm bank:										
Extraction	3,319,018	2,956,707	2,492,178	80,874	87,464	79,044	41.04	33.80	31.53	−23.2
Preparation	2,647,899	2,495,087	2,093,906	109,857	100,263	93,214	24.10	24.89	22.46	−6.8
Total or average	3,319,018	2,956,707	2,492,178	190,731	187,727	172,258	17.40	15.75	14.47	−16.8
State total: [2]										
Extraction	10,165,805	9,248,011	8,187,961	982,721	1,055,306	915,302	10.34	8.76	8.95	−13.4
Preparation	9,484,016	8,778,506	7,789,689	393,472	352,758	346,770	24.10	24.89	22.46	−6.8
Total or average	[3] 10,165,805	[4] 9,248,011	[5] 8,187,961	1,376,193	1,408,064	1,262,072	7.39	6.57	6.49	−12.2

[1] Includes personnel engaged in maintenance, haulage, stripped land surface reclamation, etc.
[2] Excludes dredged coal.
[3] Includes production without preparation, comprising 10,670 tons from deep mines and 671,119 tons from culm banks.
[4] Includes production without preparation, comprising 7,885 tons from deep mines and 461,620 tons from culm banks.
[5] Includes production without preparation, comprising 398,272 tons from culm banks.

Note: All data in this table were derived from annual reports, published by the Anthracite and Bituminous Division of the Pennsylvania Department of Environmental Resources, that summarize mandatory monthly reports submitted by the anthracite industry.

loading facilities. The prepared coal is shipped to the power company's eastern Pennsylvania generating stations. Two Alpine miners, in May 1971, started cutting extremely hard bottom rock in the No. 1 and No. 2 mines. New Kennametal U-44 bits used on these miners resulted in low cutter cost.

Consolidation Coal Co., Pittsburgh Coal Co. Division, announced plans for a $6 million coal mine near Reels Corner, Pa., in Somerset County. The mine will employ about 200 men when completed in 1973.

U.S. Natural Resources, Inc., acquired Twilight Industries, Inc., of Belle Vernon, through an exchange of stock. Twilight's operations in southwestern Pennsylvania expected a 1.2-million-ton production in 1971.

Gulf Resources & Chemical Corp. through its newly-formed subsidiary, Vantage Coal Corp., expanded the strip mining of steam-grade coal in Clarion County.

Consolidated Natural Gas Supply Corp., a Consolidated Natural Gas Co. subsidiary, acquired options to purchase coal mining rights on a substantial acreage in western Greene County and adjoining Marshall and Wetzel Counties in West Virginia.

The Bethlehem Steel Corp. acquired the Ehrenfield No. 8 mine near Johnstown from Colt Industries, Inc. The principal properties also included about 10,000 acres of coal reserves in Cambria County and a preparation plant. The low-volatile metallurgical coal produced will go to Bethlehem's steel plants.

Raise Drillers, Inc., of Amarillo, Tex., completed a 12-foot-diameter, 678-feet-deep ventilation shaft for the Helen Mining Co., a subsidiary of the North American Coal Co., at the Homer City mine. The 12-inch-diameter pilot hole was drilled through shale and sandstone at 14.5 feet per hour, and the 12-foot-diameter raise hole was drilled at 3.4 feet per hour.

A 12-foot-diameter, 593-foot-deep exhaust shaft was drilled in approximately 17 days by Raise Drillers, Inc., at the Lancashire No. 20 mine of the Barnes and Tucker Co. in Cambria County. Reportedly, the cost per foot for the 12-foot shaft was in the range of $280 to $300 per foot. Lining, when needed, was extra. Guniting cost about an additional $70 per foot.

The first longwall system applied in the Pittsburgh coal seam in the State began mining in November 1970 at the Jones & Laughlin Steel Corp. Gateway mine near Clarksville, Greene County. The system comprised one Eickhoff double-drum shearer, 110 Gullick-Dobson 510-ton yield, 6-leg chocks, one Eickhoff single-strand face conveyor, and one stage loader. Two mine-built bridges straddle the stage loader and move with it to carry electric switchgear and pumps. A wetting agent was used in the spray water.

Experimental rescue equipment was put into service on March 27, by the Westinghouse Electric Corp., in an attempt to reach two miners trapped inside the burning Nemacolin mine of the Buckeye Coal Co. in Greene County. The equipment included sound detection devices and two oil rig drills, one which could drill a 28-inch diameter shaft. The rescue attempt failed, and in late August, pumping was in progress to flood portions of the mine in an effort to extinguish the fire and to recover the bodies of the two miners.

In late November, more than 7,000 miners were idled in Armstrong, Cambria, Indiana, Somerset, and Westmoreland Counties by roving pickets who expressed dissatisfaction with the new 3-year wage contract. The picketing also halted all pollution control and backfilling operations being conducted in the area.

The United Mine Workers Union was ordered by a Federal judge on December 22 to pay $420,000 in damages to the Solar Fuel Co. of Hooversville. The judgment was the result of an antitrust suit in which the company claimed disruptive union organizing activities that cut the output of two coal mines in 1967 and 1968, property damage, and the discouragement of suppliers and customers from doing business with the company.

Three Pennsylvania coal mines of the Bethlehem Steel Corp. won the National Safety Council's Award of Honor for outstanding safety performance during 1971. The award winning mines were the Nanty Glo Mine 31 and Cambria Slope Mine 33 in the Cambria Division and the Somerset Mine 60 in the Ellsworth Division. The National Safety Council's Award of Merit for noteworthy safety achievement during 1971 was awarded to the Revloc Mine 32 in the Cambria Division and the Marianna Mine 58 in the Ellsworth Division.

Near Armagh, the Oneida No. 4 mine of

he Oneida Mining Co., a subsidiary of North American Coal Corp., was the first Pennsylvania coal mine to use the raise drilling method for shaft development. Two ventilation exhaust shafts 12 feet in diameter and 358 and 375 feet deep were completed in May 1971. The mine also was the first in the State to use two F6-A Alpine continuous miners, also termed roadheaders, for the development of roadways driven in coal and/or rock. The miners were designed for selective cutting and maneuvering in tight places. Each crawler-mounted miner had a chain conveyor, a movable tail boom, a gathering arm loading head, and a 2-foot diameter, 3-foot-long cutterhead mounted on a boom and turret that provided for cutting places 14-1/2 feet wide and 11 feet, 2 inches high. The conical-shaped cutter was designed so that only one bit was cutting at one time. The machines were able to cut hard materials with less bit wear than American-built continuous miners.

Sales of Alpine hard rock miners in the United States by the Alpine Equipment Corp., of State College, Pa., comprised four to Pennsylvania coal mines, three to coal mines in other States, two to uranium mines, and two for construction work.

Exports of bituminous coal through Philadelphia totaled 65,694 short tons.

The first interstate shipments of large tonnages of fuel coal will occur in 1974 when North American Coal Corp. begins shipments from southern Ohio to the Duquesne Light Co.'s Bruce Mansfield plant, under construction near Shippingport, Pa.

The National Bituminous Coal Wage Agreement of 1971 between the Bituminous Coal Operators' Association, Inc., and the United Mine Workers of America became effective November 12, 1971. The agreement provided for increased standard daily wage rates effective November 12 of 1971, 1972, and 1973. The bituminous coal industry resumed operations about mid-November after 44 days of idleness.

As of January 1, 1968, the State's strippable reserves of bituminous coal totaled 752 million tons, 70 percent of which contained over 2-weight-percent sulfur. The remainder of the reserves contained 1-to 2-weight-percent sulfur. One-fourth of the strippable reserves was in the Upper Freeport seam with lesser amounts in the Lower Freeport and Lower Kittanning seams. The Pittsburgh seam had less than 38 million tons of economically strippable reserves. Butler County led in strippable reserves, followed by Clearfield and Washington Counties.

The Willowbrook Mining Co., at Slippery Rock, doubled coal production at its Jackson Center mine by installing a specially manufactured diesel-electric generator on a straight electric Marion 7400 dragline. The use of the 1,400-horsepower, 1,000-kilowatt-capacity generator in this application was believed to have been the first for a 14-cubic-yard dragline.

Shipments of new equipment to the State's deep mines in 1971 included two mobile loaders, 78 continuous mining machines, one longwall unit, 93 shuttle cars, 82 gathering and haulage belt conveyors, and unknown numbers of rubber-tired tractors, mine cars, and roof drills.

The Joy Manufacturing Co., in its Franklin, Pa., plant, produced its 10,000th shuttle car for the coal mining industry. This car, with two 50-horsepower traction motors and a 330-cubic-foot capacity, was shipped to a mine in Colorado. The first car introduced by the company in 1938 had a capacity of 140 cubic feet.

Washington, Greene, Indiana, Cambria, and Armstrong Counties produced 35.1 million tons, or 79 percent, of the total deep mined coal. Clearfield, Clarion, Somerset, Armstrong, and Indiana Counties produced 16.6 million tons, or 59 percent, of the total strip mined coal. Armstrong, Indiana, Clearfield, Jefferson, and Elk Counties produced approximately 73 percent of the total auger mined coal. Collectively, Washington, Greene, Indiana, Armstrong, and Cambria Counties produced 42.2 million tons, or 58 percent, of the State's total coal production. Pennsylvania had six of the 50 largest bituminous coal mines in the United States in 1971. Collectively, five deep mines and one strip mine produced 12.69 million tons, or 10.1 percent of the 125.84 million tons produced by the 50 largest producing mines in the United States.

Active mines producing more than 1,000 tons per year totaled 765; 181 were deep mines, 17 less than in 1970; 527 were strip mines, 28 less than in 1970; and 57 were auger mines, three more than in 1970.

The 1971 production is distributed among geological beds in table 9, while

detailed productivity data for 1969, 1970, and 1971 are compared in table 10.

The 72.8-million-ton total production in 1971 was valued at $620.2 million, compared with the 80.5 million tons produced and valued at $585.1 million in 1970. The average f.o.b. mine value increased to $8.52 from $7.27 in 1970. Open market sales totaled 47.7 million tons and averaged $7.47 per ton at the mine, and 25.1 million tons of captive coal averaged $10.50 at the mine.

Approximately 50.0 million tons was transported by rail or water; 7.7 million tons by conveyor belt; and 14.8 million tons by truck. Unit-train shipments totaled 19.1 million tons, 10.3 percent less than in 1970. The remainder of the total production was distributed as follows: 403,000 tons for local domestic uses, 12,000 tons for heat and power at mines, and 383,000 tons for beehive coke production.

Sixty-eight mechanical cleaning plants, six fewer than in 1970, produced 42.63 million tons of salable coal and 14.59 million tons of refuse. The percentages of cleaned coal by origin were: Deep mines, 83.35; strip mines, 16.64; and auger mines, 0.01. Wet washing equipment by types and their production of cleaned coal in million tons were, tables, 4.98; launders, 1.34; froth-flotation, 1.66; dense medium, 16.35; classifiers, 0.72; and jigs, 10.11. Pneumatic-type equipment produced 7.47 million tons of clean coal.

Bituminous coal cleaning facilities contracted for in 1971 by five purchasers had a total capacity of 1,617 tons per hour. At 7 hours per day and 220 days operation per year, this new equipment was capable of producing 2.49 million tons per year of cleaned coal.

Seven companies operated 11 thermal drying units to produce 6.06 million tons. Of the 48.53 million tons of coal crushed in 188 plants, 40.87 million tons was cleaned at plants performing crushing.

Thirteen companies in seven counties operated 26 plus-500,000-ton-per-year deep mines whose total production was 26.60 million tons, or 60 percent of the total underground production.

The 1971 DER Annual Report of the Anthracite and Bituminous Coal Divisions listed 202 deep mine operations producing 44.36 million tons: 16 were shaft mines with 12.87 million tons production; 36 were slope mines with 17.68 million tons production; 149 were drift mines with 13.77 million tons production, and one operation, listed as an underground mine, produced 39,800 tons of salable product by processing mine refuse. Sixty-six deep mines were classed as gaseous and 136 as nongaseous. The numbers and types of lamps used in deep mines comprised 10 open flame, 4,721 safety flame, and 19,926 electric. Underground mining and its supporting services employed 18,624 persons. The 32 fatalities incurred by the bituminous coal industry equaled one per 2,236,000 tons of production, or 5.91 per million man-days. Nonfatal injuries totaled 970, equal to one per 76,031 tons of production or 173.53 per million man days. Underground mines used 785,045 total pounds of permissible explosives, four mines used both permissible explosives and Airdox to produce 2,359,000 tons of coal, and three mines used Airdox as the sole breaking agent to produce 546,766 tons of coal. A small number of deep mines classed as hand loaded employed 10 shot firers, 43 pick miners, and 38 miners to perform hand loading and operate mechanical loaders. All deep mines had 8,050 employees operating mechanical loading machines.

Continuous mining machines totaled 501, 37 more than in 1970, and produced 37.57 million tons of coal, 8.55 million tons less than in 1970. These machines comprised ripper, boring, oscillating-disc-head, and rotary drum types. Because 21 machines were not designed to perform loading, 34 mobile loaders were teamed with these 21 continuous mining machines to load 1.64 million tons from the mine floor. Seventy continuous mining machines mined and loaded 3.40 million tons onto feeder-conveyors, and 410 machines mined and loaded 32.53 million tons into shuttle cars.

Nine longwall systems produced approximately 1,925,000 tons of coal, 6,000 tons more than the 1,919,000 tons produced by 10 longwall systems in 1970. In 1971, one planer-type installation produced 197,294 tons and eight shearer-type installations produced 1,727,749 tons. The longwall installations were operated in coal seams ranging from 43 to 78 inches in thickness under 200 to 800 feet of cover. The blocks of coal mined ranged from 400 to 600 feet in face length and 2,550 to 2,880 feet in

panel depth. The number of men for one crew shift ranged from seven to 10, and the run-of-mine coal production during one crew shift ranged from 700 to 1,277 tons.

Seventeen mobile loaders discharged 270,920 tons into mine cars or onto conveyors, and 4,301,477 tons were loaded into shuttle cars and rubber-tired mine cars by 69 mobile loaders. The remainder of the mechanically loaded coal, totaling 51,683 tons, was loaded by 10 duckbill or scraper conveyors. Coal loaded by hand totaled 169,000 tons.

A total of 135 cutting machines, 19 fewer than in 1970, were used to cut 4,776,317 tons. Coal shot from the solid totaled 17,964 tons.

Coal drilling by 80 hand-held or post-mounted drills, 48 fewer than in 1970, was used to produce 1,543,456 tons of coal, and 38 mobile drills, 26 more than in 1970, were used to produce 3,250,299 tons of coal.

Roof bolting employed 276 rotary drills, five more than in 1970, and 265 percussion drills, 26 less than in 1970. Roof or rock drills used for other purposes included 38 rotary drills, 15 more than in 1970, and 32 percussion drills, 12 less than in 1970.

Equipment used for the haulage of run-of-mine coal, rock, operating supplies, and personnel in deep mines included 1,022 trolley locomotives, 47 more than in 1970; 68 battery-powered locomotives, 18 more than in 1970; 12,576 seven-ton-capacity rail mine cars, 1,442 fewer than in 1970; 473 miles of mainline track and 287 miles of other track; and 619 gathering and haulage conveyor belts, 57 more than in 1970, averaging 1,921 feet in length and totaling 225.1 miles compared with 199.6 miles in 1970. Considerable intermediate haulage was done by 1,060 cable reel shuttle cars and 61 battery-powered shuttle cars, six shuttle buggies, 218 rubber-tired tractors, 848 rubber-tired trailers, and 65 rubber-tired mine cars.

Seventy-seven mines installed 8,580,814 roof bolts, all new, as either the sole method of roof support or in conjunction with other roof support materials. These 77 mines produced approximately 43 million tons of coal including approximately 35 million tons produced under roof supported only by bolts. The State produced approximately 14 percent of the total bituminous coal produced under bolted roof in the United States and installed approximately 17 percent of the total roof bolts used in such production.

Strip mining equipment included 467 power shovels, 103 less than in 1970, and 326 draglines, 38 less than in 1970. Approximately 90 percent of the shovels and drag lines were diesel-powered and 73 percent were rated at less than 5-cubic-yard capacity. Of the 38 carryall scrapers in operation, 28 more than in 1970, 11 were rated at less than 15-cubic-yard capacity. Other strip mining equipment included 849 bulldozers, 32 horizontal drills, 116 vertical drills, 328 front-end loaders, 11 wheel excavators, five power brooms, 51 motor graders, and five coal drills. No data were available for the truck haulage of run-of-mine coal. The 28.0-million-ton strip mined production averaged $6.41 per ton f.o.b. mine, compared with a $5.38 average f.o.b. mine value for the 24.4-million-ton production in 1970. The C & K Coal Co. was the largest producer of strip mined coal with 2,375,235 tons from 15 operations, all in Clarion County.

Strip and auger mining consumed 31,271 pounds of permissible explosives, 9,375,890 pounds of dynamites, and 104,312,481 pounds of processed and unprocessed ammonium nitrate.

Active equipment for auger mining included 58 augers, 45 bulldozers, two carryall scrapers, one diesel shovel rated at less than 5-cubic-yard capacity, and seven front-end loaders. The 544,211-ton auger mined production averaged $6.04 per ton at the mine, compared with a $5.52 per ton average f.o.b. mine value for the 661,000-ton production in 1970.

Coke.—Nine companies operated 12 oven-coke plants, two classified as merchant and 10 as furnace, and received 22,721,000 tons of coal. Kentucky supplied 1,262,000 tons; Pennsylvania, 12,081,000 tons; Virginia, 600,000 tons; and West Virginia, 8,778,000 tons. Collectively these 12 plants carbonized 21,883,647 tons of bituminous coal and 98,147 tons of anthracite to produce 15,260,638 tons of breeze-free metallurgical coke, 97.3 percent of which was blast furnace grade valued at $32.62 (average) per ton. The 12 plants also produced 751,239 tons of coke breeze, and byproducts comprising fuel gas, nitrogen fertilizers,

Table 8.—Bituminous coal production, by type of mine and county

(Excludes mines producing less than 1,000 short tons annually)

County	Number of mines				Production (thousand short tons)				Value (thousands)[1]
	Underground	Strip	Auger	Total	Underground	Strip	Auger	Total	
Allegheny	8	6	--	14	3,281	730	--	4,011	$36,162
Armstrong	19	57	17	93	4,679	2,628	163	7,470	50,785
Beaver	1	5	2	8	W	W	W	W	W
Bedford	2	--	--	2	4	--	--	4	W
Butler	6	27	2	35	577	876	36	1,489	9,453
Cambria	23	17	--	40	5,581	757	--	6,338	80,286
Centre	2	16	--	18	W	W	W	--	7,234
Clarion	1	42	--	43	2	4,198	--	4,200	29,789
Clearfield	11	93	6	110	1,100	5,697	62	6,859	45,818
Clinton	--	5	--	5	--	406	--	406	2,549
Elk	1	7	3	11	W	W	W	W	W
Fayette	4	49	2	55	657	890	14	1,561	13,058
Fulton	--	1	--	1	--	3	--	3	18
Greene	15	16	--	31	7,474	906	--	8,380	80,060
Indiana	35	34	7	76	6,111	1,375	78	7,564	73,014
Jefferson	7	35	7	49	161	1,198	59	1,418	10,408
Lawrence	--	12	5	17	--	744	28	772	3,792
Lycoming	--	2	--	2	--	83	--	83	333
Mercer	--	4	--	4	--	407	--	407	2,614
Somerset	27	46	3	76	1,135	2,678	27	3,840	28,844
Tioga	--	2	--	2	--	986	--	986	4,333
Venango	--	8	--	8	--	369	--	369	1,947
Washington	12	16	3	31	11,231	1,217	33	12,481	114,158
Westmoreland	7	27	--	34	1,743	645	--	2,388	20,846
Undistributed [2]	--	--	--	--	553	1,209	44	1,806	4,695
Total	181	527	57	765	44,289	28,002	544	72,835	620,196

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Value received or charged for coal f.o.b. mine. Includes a value for coal not sold but used by producers if such coal has been sold commercially.

[2] Includes production and values indicated by symbol W.

Table 9.—Bituminous coal production by coalbed

(Thousand tons)

Coalbed (Geological name)	Thickness, inches	Underground	Strip	Auger	Total
Bakerstown	18–28	XX	101	XX	101
Bloss, Morgan and Seymour	22–28	XX	873	XX	873
Brookville	24–54	737	1,589	XX	2,326
Clarion	18–50	XX	2,252	XX	2,252
Clarion-Brookville	26–52	XX	158	XX	158
Clarion-Kittanning	28–48	XX	1,671	XX	1,671
Freeport	30–55	XX	277	XX	277
Freeport, Lower	22–100	3,984	1,061	92	5,137
Freeport, Upper	20–48	4,962	2,810	104	7,876
Freeport, Lower and Upper	28–56	XX	2,257	16	2,273
Freeport, Double	84–86	1,686	XX	XX	1,686
Freeport, Middle	30	XX	XX	7	7
Freeport, Thick	78–108	1,583	XX	XX	1,583
Freeport, Kittanning	12–56	XX	1,649	XX	1,649
Kittanning	16–20	XX	286	28	314
Kittanning, Lower	20–60	8,955	3,089	134	12,178
Kittanning, Middle	16–34	258	1,728	113	2,099
Kittanning, Upper	38–96	1,311	676	XX	1,987
Kittanning, Lower and Middle	10–60	XX	1,382	32	1,414
Mahoning	42–43	3	30	XX	33
Mercer	6–36	XX	20	XX	20
Pittsburgh	36–108	19,831	2,724	14	22,569
Redstone	24–40	2	428	XX	430
Sewickley	42–60	1,004	218	XX	1,222
Uniontown	32–36	XX	70	XX	70
Waynesburg	36–72	XX	1,245	19	1,264
Other	20–48	[1] 40	[2] 62	XX	102
Total	XX	44,356	26,656	559	71,571

XX Not applicable.

[1] Listed as underground production although obtained by the reprocessing of refuse dump material.

[2] Comprises production from five beds: "A" Rider, 7; Brush Creek, 40; Cannel, 1; Clay Rider, 11; and Fulton Barnet, 3.

NOTE:—All data shown in this table were derived from information contained in the Annual Report, published by the Anthracite and Bituminous Division of the Pennsylvania Department of Environmental Resources, which summarizes mandatory monthly reports submitted by the bituminous industry.

Table 10.—Bituminous coal production, [illegible]

Activity	Production (thousand short tons)			Man-days (thousands) [1]			Productivity (tons per man-day) [1]			Percent change in 1969–71 period
	1969	1970	1971	1969	1970	1971	1969	1970	1971	
Underground:										
Captive (mined and cleaned):										
Mining	28,370	28,822	21,857	2,198.3	2,415.8	2,023.6	12.91	11.93	10.80	−16.3
Cleaning	28,370	28,822	21,857	206.3	212.7	161.6	137.52	135.51	135.25	−1.7
Total or average	28,370	28,822	21,857	2,404.6	2,628.5	1,185.2	11.80	10.97	10.00	−15.3
Noncaptive (mined and cleaned):										
Mining	16,108	18,941	16,480	1,011.2	1,232.0	1,323.2	15.93	15.37	12.45	−21.8
Cleaning	16,108	18,941	16,480	124.9	121.7	101.1	128.97	155.64	163.01	+26.4
Total or average	16,108	18,941	16,480	1,136.1	1,353.7	1,424.3	14.18	13.99	11.57	−18.4
Noncaptive (mined and crushed):										
Mining	11,577	7,579	6,019	708.9	603.3	492.6	16.33	12.56	12.22	−25.2
Crushing	11,577	7,579	6,019	35.4	34.0	29.5	327.03	222.91	204.03	−37.6
Total or average	11,577	7,579	6,019	744.3	637.3	522.1	15.55	11.89	11.53	−25.9
Strip:										
Noncaptive (mined and cleaned):										
Mining	6,760	9,261	10,241	294.5	395.6	430.6	22.95	23.41	23.78	+3.6
Cleaning	6,760	9,261	10,241	59.4	60.7	66.5	113.80	152.57	154.00	+35.3
Total or average	6,760	9,261	10,241	353.9	456.3	497.1	19.10	20.30	20.60	+7.9
Noncaptive (mined and crushed):										
Mining	14,893	14,900	16,415	648.8	636.4	690.5	22.95	23.41	23.77	+3.6
Crushing	14,893	14,900	16,415	45.6	66.9	80.4	326.60	222.72	204.17	−37.5
Total or average	14,893	14,900	16,415	694.4	703.3	770.9	21.45	21.19	21.29	−0.7
Auger:										
Noncaptive (mined and cleaned):										
Mining	61	42	59	2.1	1.1	1.6	29.05	38.18	36.88	+27.0
Cleaning	61	42	59	.5	.3	.4	122.00	140.00	147.50	+20.9
Total or average	61	42	59	2.6	1.4	2.0	23.46	30.00	29.50	+25.7
Noncaptive (mined and crushed):										
Mining	416	548	500	14.6	13.9	13.4	28.49	39.42	37.31	+31.0
Crushing	416	548	500	1.3	2.5	2.5	320.00	219.00	200.00	−37.5
Total or average	416	548	500	15.9	16.4	15.9	26.16	33.41	31.45	+20.2
Total captive and noncaptive:										
Mining	78,185	80,093	71,571	4,878.4	5,298.1	4,975.5	16.03	15.12	14.38	−10.3
Cleaning	51,299	57,066	48,637	391.1	395.4	329.6	131.17	144.32	147.56	+12.5
Crushing	26,886	23,027	22,934	82.3	103.4	112.4	326.68	222.70	204.04	−37.5
Total or average	78,185	80,093	71,571	5,351.8	5,796.9	5,417.5	14.61	13.82	13.21	−9.6

[1] Includes personnel engaged in maintenance, haulage, stripped land surface reclamation, etc.

Note: All data in this table were derived from annual reports, published by the Anthracite and Bituminous Division of the Pennsylvania Department of Environmental Resources, that summarize mandatory monthly reports submitted by the bituminous industry.

tar, naphthalene, pitch, and crude light oil and its derivatives.

Pennsylvania ranked first in oven-coke production, with 27 percent of the total production in the United States.

Exports of coke through Philadelphia totaled 154,556 short tons.

Ten iron and steel works operated by seven companies had integral coke plants with a total of 3,361 slot-type ovens, 1,375 of which were in the world's largest coke plant at Clairton. The two merchant coke plants had 132 slot-type ovens.

Four beehive coke plants operated by four companies in Armstrong, Fayette, and Indiana Counties produced 248,930 tons of coke, all of which was blast furnace grade. The four beehive plants collectively used 431,272 tons of bituminous coal, of which 383,214 tons came from Pennsylvania mines. The average coke yield for the four plants was 57.72 percent.

Two unpublished papers relating to coke oven gas purification were presented at the Annual Joint Meeting of the Eastern States and the Western States Blast Furnace and Coke Plant Associations in Pittsburgh, October 8, 1971. The papers were titled: The Past, Present and Future of H_2S Removal Systems; and U.S. Steel's Keystone Project.

In March, the Koppers Co. started to supply industrial coke to the foundry market from 58 recently activated ovens owned and operated by Interlake, Inc., in Erie, Pa. This new 12,000-ton-per-month output replaced that from Kopper's recently closed coke plant at Kearny, N.J.

Experimental work to produce coke pellets has been conducted by Consolidation Coal Co. since 1960 in a 15- to 30-ton-per-day pilot plant at Library at a total cost of $7 million. Based on the results of the work, a $20 million, 500-ton-per-day demonstration plant will be built at Sparrows Point, Md. Engineering work was underway in 1971 for the plant, which is scheduled to begin operations in 1974. Companies backing the project include Bethlehem Steel Corp., Consolidation Coal Co., Granite City Steel Co., National Steel Corp., and Republic Steel Corp. The main objective of the venture will be to provide the engineering data necessary, if the process proves technically successful, to construct production size pelletizing plants with capabilities of 2,000 to 5,000 tons per day. The process is designed to use either coking-grade or weakly coking-grade coal. Other objectives are to curtail gas and dust emissions at coke works, to stretch the supply of low-volatile coal by using a single high-volatile coal, and to use surplus gas from the process, after cleaning, in steel plants and for power generation.

The Bethlehem Steel Corp. received U.S. Patent 3,623,973 for breaking coal tar residues into useful chemical compounds. In the process covered by the patent, hydrocracking produces two- and three-ring compounds that, in the presence of hydrogen, are converted into one- and two-ring aromatics such as naphthalene, benzene, and benzene homologs.

The State's Air Pollution Commission filed a suit claiming that beehive coke ovens operated by the Bortz Coal Co., in Fayette County, produced air polluting emissions in excess of legal limits. The case was dismissed because the expert witness had not employed any of the instruments available for testing emissions.

The EPA in May sought an injunction through the Department of Justice under the River and Harbor Act of 1899 to stop pollution of the Monongahela River by the Monessen plant of the Wheeling-Pittsburgh Steel Co. Reportedly, water samples taken in February showed that the plant discharged a daily average of 2,270 pounds of phenolics, 179 pounds of cyanide, and 30,301 pounds of suspended solids.

A spokesman for DER stated that the United States Steel Corp. proposed a plan whereby 2.5 million gallons per day of waste water would be discharged from the Clairton Coke Works to the Allegheny County Sanitary Authority (Alcosan). The plan would require additional treatment facilities and create some maintenance problems at the Alcosan plant. Reportedly, the daily waste water discharged from the Clairton works included 21,000 pounds of phenolics, 20,000 pounds of free ammonia, 40,000 pounds of fixed ammonia, 2,100 pounds of cyanide, 15,000 pounds of cyanate, and 125,000 pounds of dissolved solids.

The United States Steel Corp. was sued by Allegheny County and the Commonwealth to compel the company to curb pollution outside and inside the Clairton Coke Works. The suit asked that the firm be ordered to stop quenching coke with contaminated water, reduce SO_2 emissions,

prevent pollutants from leaking out of coke ovens, reduce employee exposure to coal tar fumes, and begin significant research to find new ways to decrease the quantity of air pollutants emitted at Clairton.

Natural Gas Liquids.—The total quantity of natural gas liquids produced was less than in 1970, but the average value per barrel was greater than in 1970. Proved reserves of natural gas liquids totaled 817,000 barrels at yearend compared with 896,000 barrels at yearend 1970.

At the start of the year, two natural gas processing plants with a daily gas capacity of 8.0 million cubic feet had a 3.3-million-cubic-foot daily throughput. The average daily production of liquids comprised 3,000 gallons of propane, 1,200 gallons of normal butane, and 2,100 gallons of debutanized natural gasoline. The Mars Co. operated these two plants, the Lamont plant in the Kane field in Elk County and the Van plant in the Strong field in Venango County near Oil City.[7]

Peat.—Ten operations in seven counties reported a total production of 38,850 short tons, 21.2 percent less than in 1970. The total production comprised 1,200 tons that were shredded and kiln dried and 37,650 tons that were shredded only. Luzerne County was the leading producer with 16,770 tons, followed by Lackawanna County. The other producing counties were Columbia, Erie, Lawrence, Monroe, and Wayne.

Sales totaling 38,186 tons, at an average value of $12.08 per ton, were 12.8 percent less and averaged 38 cents per ton more than in 1970. Sales of bulk peat for general soil improvement totaled 22,145 tons and averaged $11.03 per ton. Total sales and average value by type comprised 8,382 tons of moss at $12.98 per ton; 18,510 tons of reed-sedge at $10.59 per ton; and 11,294 tons of humus at $13.87 per ton.

Petroleum and Natural Gas.—Crude petroleum production was 7.2 percent less than in 1970 despite the startup of several waterflood projects. The average value, $4.66 per barrel at the well, was 14 cents per barrel greater than in 1970. Compared with the 31.4-million-barrel production in 1891, the Pennsylvania-grade crude petroleum production in 1971 totaled 3,733,000 42-gallon barrels valued at $17.49 million, or $4.68 per barrel, with an additional 65,000 barrels of Corning-grade crude oil valued at $209,300, or $3.22 per barrel, and produced in Crawford and Erie Counties from the Medina (Lower Silurian) Sandstone. The Corning production was off 442 barrels from that of 1970.

The number of producing wells, all of which were strippers, decreased from 36,801 in 1970 to 34,029 in 1971. Estimated proved recoverable reserves of crude oil at yearend totaled 47.0 million barrels, a decrease of 4.3 million barrels from that of yearend 1970. Indicated reserves of crude oil economically available by fluid injection totaled 32.8 million barrels.[8]

Natural gas production totaled 76.5 billion cubic feet, a decrease of 0.5 percent from that of 1970. A total of 63.6 billion cubic feet of gas was produced from the shallow (Upper Devonian or younger) reservoirs, while production from the deep (Middle Devonian or older) reservoirs totaled 12.9 billion cubic feet. The estimated number of producing gas wells increased from 16,548 in 1970 to 16,586 in 1971. Estimated proved reserves of natural gas totaled 1,396 billion cubic feet including 616 billion cubic feet in storage at yearend. This was an increase of 31 billion cubic feet from that of 1970.

According to the American Gas Association, underground natural gas storage facilities in Pennsylvania on December 31, 1971, comprised 66 pools serviced by 2,135 wells and equaled about 17 percent of the U.S. reservoir capacity.

According to the Bureau of Topographic and Geologic Survey, 693 new wells were drilled and 88 wells were deepened during 1971. Of these, 387 were oil, 182 gas, 60 service, 32 gas storage, and 32 dry holes. Of the old wells drilled deeper, 21 were gas, three oil, 48 gas storage, and 16 dry. Total footage of all wells (781) drilled was 1,440,689. Of 641 well completions, 22 were exploratory (18 percent successful) and 619 were development (95 percent successful). Deep drilling (Middle Devonian or older) increased from 90 wells in 1970 to 106 wells in 1971, including 48

[7] Oil and Gas Journal. V. 69, No. 28, July 12, 1971, pp. 84, 96.

[8] Oil and Gas Journal. Slump in Drilling Again Trims U.S. Oil and Gas Reserves. V. 70, No. 14, Apr. 3, 1972, pp. 18–20.

wells drilled deeper. As in 1970, the majority of the deep development drilling was in the Medina gas area of Crawford County where nine gas wells were drilled in the Indian Springs field. Three of these nine wells produced Corning-grade crude oil along with the gas, with initial oil productions ranging from 10 to 50 barrels of oil per day. Most of the activity in the shallow gas fields was in the following counties: Indiana—95 gas wells, Jefferson—17, and Armstrong—16. The majority of the shallow oil development was carried on in the following counties: Warren—144 oil wells with Glade sand production, Venango—142 wells producing from the Red Valley and Venango Second sandstones, McKean—48 wells producing from the Bradford and associated sandstones, and Forest—41 wells with production from the Red Valley and Venango Second sandstones. Seismic activity was at an alltime high during the year with most of it being the vibroseis (shock wave) type. Seismic crews logged 147 crew-weeks during 1971 compared with 45 crew-weeks during 1970, an increase of 227 percent. The seismic surveys were made in Bedford, Blair, Bradford, Cambria, Cameron, Centre, Clearfield, Clinton, Crawford, Elk, Erie, Forest, Fulton, Greene, Indiana, Jefferson, Lackawanna, Lawrence, Lycoming, McKean, Mercer, Pike, Potter, Susquehanna, Tioga, Venango, Warren, Washington, Wayne, and Wyoming Counties. A total of 2,778 acres in Pike County were leased to bidders by the Pennsylvania Game Commission during the year. The bonus bid was $21,588.17 with a rental of $1.00 per acre and a royalty of $0.04 per thousand cubic feet (Mcf). At the end of 1971, the Commission had 28 active leases totaling 14,680.9 acres. Thirty-six wells were producing on the 28 leases. No wells were drilled on the leases during 1971. Through competitive bidding, 3,840 acres in Bedford County, 5,022 acres in Cameron County, and 7,542 acres in Cameron and Potter Counties of State Forest and Park lands were leased during 1971. The total bonus or first-year rental received for these tracts was $230,075.33. The average of all sales was $7.43 per acre. After the first year, the rental is $1 per acre per year with royalties equal to one-eighth or better of all production. The income relative to oil and gas exploration and development from State Forest and Park lands was $509,370 which royalty payments amounted to $139,658 for 1,407,463 Mcf of gas produced on the lands and $369,712 for tract rentals, gas storage, right of ways, etc. At yearend, there were 157,085 acres (59,109 acres for gas storage) of State Forest and Park lands under lease for oil and gas exploration and development.

American Petroleum Institute data for oil and gas exploratory and development drilling are shown in table 11.

Some average characteristics of the Bradford oilfield are depth to sand, 1,000 to 2,000 feet; thickness, 50 feet; porosity, 15 percent; permeability, 10 millidarcys; oil saturation, 30 to 60 percent; water saturation, about 10 percent; about 100 cubic feet of gas produced per barrel of 45.5 API gravity crude produced; and a low original reservoir pressure of about 350 pounds per square inch (no good figure available). In the 1870–1970 period, production in the Bradford field totaled 646.8 million barrels, comprising 273.1 million barrels by primary recovery and 373.7 million barrels by secondary recovery methods. Of the total oil produced in Pennsylvania to the end of 1970, which amounted to 1,269.5 million barrels, over 43 percent was produced from the Pennsylvania part of the Bradford field. If the Marathon Oil Co.'s Maraflood, or some other tertiary recovery process proves economically feasible, the field could produce as much oil as it has in the past. If waterflooding continues to be the main recovery method, production will continue to decline and the life of the field will be terminated in the not too distant future.[9]

Active rotary-drill weeks totaled 484. Only six rotary drills were active in the weeks ending January 6, March 15 and 22, and December 13 and 27. The maximum activity was in the week ending May 3, when 14 rotary drills were in operation.

A pilot Maraflood project was completed in a section of the Bradford field in McKean County. The project had 16 injection wells and 25 producers on a 45-acre tract. The oil was produced in the Bradford Third Sandstone at an 1,800-foot depth. In May 1971, a second Maraflood project was

[9] Pennsylvania Geology (Pennsylvania Geological Survey). Bradford, The First Giant Oil Field. V. 2, No. 4, August 1971, pp. 34–36.

started in the water-wet First Venango Sandstone at a 500-foot depth in the Goodwill Hill area of Warren County. This project consisted of a 10-acre tract with nine injection wells and 12 producers. The sandstone in this area had been gas driven but never water flooded.

In June, there were four aboveground liquefied natural gas (LNG) facilities in Pennsylvania, as follows:

Company and plant site	Liquefaction plant capacity (million cubic feet per day)	Storage capacity		Initial year of operation
		Million cubic feet	Thousand barrels	
Philadelphia Electric Co., West Conshohocken	6.6	1,200	348	Under construction
Philadelphia Gas Works, Philadelphia	16.0	4,000	1,200	1969
Do [1]	--	250	73	1971
UGI Corp. Reading Division, Reading	--	250	73	1971

[1] Sole supplier to UGI Corp., Reading Division at Reading, Pa.

Source: Pipeline and Gas Journal, v. 198, No. 7, June 1971, pp. 44–46.

The Statistical Committee of the Natural Gas Processor's Association in its 1971 liquefied petroleum gas (LPG) storage survey reported the State's total capacity for underground LPG storage as 1,091,000 barrels. One company in Delaware County had storage capacity for 500,000 barrels of butane, 400,000 barrels of propane, and 75,000 barrels of propylene. In Westmoreland County, one company had capacity for 116,000 barrels of n-butane. One gas works in Philadelphia County had 54 aboveground tanks for storing 1,620,000 barrels of LPG.[10]

Marketed production of natural gas averaged 209 million cubic feet per day at 27.7 cents per thousand cubic feet at the wellhead.

Of the 26,000 square miles in the Plateaus Province, only one-half of the stratigraphic interval had been evaluated for oil and gas in 40 percent of the area at year-end. In the remainder of the area, more than 10,000 feet of favorable section associated with a wide array of structures has not been explored. The total volume of the Appalachian Plateaus Province sediments is roughly 90,000 cubic miles of which only an estimated 17 percent has been drilled adequately.[11]

On May 10, the Federal Power Commission affirmed a January 8 decision that denied the Pennsylvania Gas and Water Co. of Wilkes-Barre the direct purchase of 23,845,000 cubic feet of gas daily from the Transcontinental Gas Pipe Line Corp. (Transco), of Houston, Tex. Transco continued to deliver this amount of gas to Pennsylvania Gas for the account of Manufacturers Light and Heat Co. of Pittsburgh. Transco said it did not have sufficient gas supplies to provide the same amount to both Manufacturers and Pennsylvania Gas.

The Philadelphia Gas Works awarded a $19,956,000 contract for two 583,000-barrel-capacity prestressed-concrete LNG storage tanks designed by the Preload Engineering Co. The unique tanks will have a second prestressed concrete wall designed to the same criteria as the primary liquid-containing tank wall, plus a 10-foot-wide concrete berm in the protective system.

On June 1, the Federal Power Commission authorized the Consolidated Gas Supply Corp., of Clarksburg, W.Va., and Transcontinental Gas Pipe Line Corp. and Texas Eastern Transmission Corp., both of Houston, Tex., to jointly develop the Tamarack and Leidy gas storage fields in north-central Pennsylvania at an estimated cost of $6,530,500. The three firms will recomplete six existing wells and drill five new wells in the Tamarack pool. Additionally, the three firms will build about 4 miles of 12-inch gathering line and related well lines and will add engine controls and other equipment at the Leidy station. The Commission conditioned its authorization by requiring semiannual reports on the operation of the Tamarack facilities until the maximum 11.2-billion-cubic-foot storage limit is reached.

Construction of a new LNG plant for the Philadelphia Electric Co. progressed satisfactorily, with preliminary operation

[10] Oil and Gas Journal. V. 69, No. 10, Mar. 8, 1971, pp. 87–92.

[11] Kelley, Dana R., William S. Lytle, Walter R. Wagner, and Louis Heyman. The Petroleum Industry and the Petroleum Province in Pennsylvania, 1970. Pennsylvania Geological Survey., Fourth Series. Miner. Res. Bull. M65, 1970, 39 pp.

expected in early 1972. When completed in 1972, the plant will store up to 1.2 billion cubic feet of natural gas and will be capable of providing 200 million cubic feet of gas per day during periods of peak demand.

Pennzoil United, Inc. completed the 1ASCS unit in Section D, Elders Ridge Quadrangle, Kiskiminitas Township, that flowed 2.6 million cubic feet of gas per day from Chert and Oriskany-Devonian rocks at 7,305 and 7,442 feet, respectively.

Consolidated Gas Supply Co.'s No. 1 discovery well, located 4 miles northeast of Emporium, in the Department of Forests and Waters Tract 153, had a final flow of 13.93 million cubic feet of gas per day following fracture of Oriskany-Devonian rocks at 6,653 to 6,683 feet.

Two Onondoga reef discoveries in New York State stimulated the leasing of land in Pennsylvania's Potter and Tioga Counties. The Natural Fuel Gas Co., the Weaver Oil & Gas Corp., and the Amoco Production Co. leased several million acres in 17 Pennsylvania counties and in 10 New York counties and planned to drill at least five wells in 1972 and eight wells in 1973. A discovery gas well in the newly discovered East Emporium field of Cameron County had an initial production of 14 million cubic feet per day. A deep wildcat in Pike County was being drilled to a depth in excess of 12,000 feet. Exploratory drilling during the year led to the discovery of a small oil pool, a small shallow gas pool, and an Oriskany gasfield.

The crude petroleum feed capacity and lubricating oil production capacity of the State's 12 refineries were—

Type of feed	Interstate and foreign asphalt base		Pennsylvania grade	
	1-1-71	1-1-72	1-1-71	1-1-72
Crude capacity:				
Barrels per calendar day	616,100	616,300	32,970	34,520
Barrels per stream day	644,500	646,520	34,940	36,495
Total feed—million barrels	224.9	225.0	12.0	12.6
Lubricating oil production capacity:				
Barrels per stream day	21,200	17,000	11,495	12,578
Estimated annual production—million barrels	7.4	5.9	3.9	4.3

Sources: Oil and Gas Journal. V. 69, No. 12, Mar. 22, 1971, pp. 114–115.
Oil and Gas Journal. V. 70, No. 13, Mar. 27, 1972, pp. 152–154.

The Atlantic Richfield Co. started a $45 million program at its Philadelphia refinery to make fuel products only instead of a full line of products such as waxes, solvents, and process oils. The program will cut employment at the refinery from a current 2,200 jobs to about 900. A 35-long-ton-per-day Pan Am sulfur plant was completed in the same refinery by Pan Am Engineers, and construction was in progress on a new 30,000-barrel-per-day catalytic reformer.

The Sun Oil Company, at Marcus Hook, was constructing facilities using refinery streams to produce 1,000 barrels per day of benzene, 2,800 barrels per day of toluene, 1,000 barrels per day of mixed xylenes, 340 million pounds per year of propylene, 450 barrels per day of propylene tetramer, 1,000 barrels per day of propylene trimer, 350 tons per day of ammonia, 30 long tons per day of sulfur, and 130 barrels per day of naphthenic acids.

A 4,000-barrel-per-day vacuum addition was completed in December at the Kendall Refining Co.'s Bradford refinery. This addition increased the plant's capacity to 10,000 barrels per day of crude feed.

In midyear, the Foster Wheeler Corp. completed a 2,500-barrel-per-day lube-oil hydrocracking unit for Pennzoil United Inc., at Oil City.

A hydrofluoric acid alkylation 8,700-barrel-per-day unit was being constructed by the Foster Wheeler Corp. for the BP Oil Corp. at Marcus Hook. At the same refinery construction was in progress on petrochemical facilities to convert petroleum fractions and refinery gas into aliphatic aromatic solvents, 12 million pounds per year of paraxylene, 52 long tons per day of sulfur, 400 barrels per day of toluene, and 1,000 barrels per day of xylene solvents.

In December, the Gulf Oil Corp. announced a 3-year, $30 million program to make its refinery at Philadelphia one of the most pollution-free units of its type in the world. The program will include a new waste water treatment plant, equipment to eliminate 137 tons per day of car-

bon monoxide and to trap particulates from two catalytic cracking units, and the installation of vapor seals on hundreds of valves, pumps and loading facilities, and floating roofs on scores of storage tanks. The program will be financed by $25 million from bonds issued by the Philadelphia Authority for Industrial Development and $5 million financed by the corporation.

The Pennsylvania Refining Co., at Karns City, completed a 1,050-barrel-per-stream-day facility to produce hydrotreated petroleum products using the Gulf Research and Development Co. process.

The Firestone Plastics Co., a division of the Firestone Tire & Rubber Co., had petrochemical facilities under construction at Pottstown to produce 80,000 tons per year of polystyrene butadiene latexes and vinyl resins from vinyl chloride monomer and petroleum base stocks.

Petrochemical production facilities were being built at the Neville Island, Pa., plant of the Neville Chemical Co., where solvents and thermoplastic resins will be made from unsaturated petroleum fractions, and at the Clairton and West Elizabeth, plants of the Pennsylvania Industrial Chemical Corp., where petroleum base stocks, aromatic olefins and diolefins, and nitrites will be converted into a variety of resins, emulsions, polymers, copolymers, and plasticizers.

The Rohm and Haas Co. was constructing facilities at Bristol and at Philadelphia, where 25 million pounds per year of formaldehyde will be made from natural gas at each location.

Power Generation.—At yearend, the installed capacity of the State's 108 utility generating plants in megawatts (MW) by type was: Hydro, 1,651; steam, 17,377; gas turbine, 1,809; internal combustion, 109; and total, 20,946. Two nuclear-powered generating plants accounted for 130 megawatts of the 17,377-MW total capacity listed as steam powered. At yearend, the State had four mine-mouth generating stations: The Hatfield's Ferry station in Greene County, and the Conemaugh, Homer City, and Keystone stations in the Chestnut Ridge area. Only the Keystone station was operating at full capacity. The Conemaugh, Homer City, and Keystone stations have a combined design capacity of 4,880 megawatts.

The Montour station, under construction by the Pennsylvania Power & Light Co. (PP&L) near Washingtonville in Montour County, will have two 790-megawatt-capacity generating units fueled by coal delivered from Cambria County by PP&L unit trains.

Table 11.—Oil and gas well drilling completions, by county

County	Proved field wells [1]			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Armstrong	--	21	3	--	--	1	25	69,214
Butler	1	--	--	--	--	--	1	1,322
Cambria	--	1	2	--	--	--	3	17,688
Cameron	--	--	--	--	--	1	1	6,153
Clarion	3	4	--	--	--	1	8	15,518
Clearfield	--	10	--	--	--	3	13	43,995
Crawford	4	6	3	--	--	1	14	45,636
Elk	7	1	1	--	--	--	9	16,868
Erie	--	3	--	--	--	--	3	10,046
Fayette	--	4	--	--	2	--	6	18,237
Forest	41	3	--	--	--	2	46	47,874
Fulton	--	--	--	--	--	1	1	2,870
Indiana	--	111	10	--	1	1	123	402,375
Jefferson	--	18	1	--	--	1	20	59,710
Lackawanna	--	--	1	--	--	--	1	4,233
McKean	48	3	--	--	--	1	52	93,436
Potter	4	--	--	--	--	1	5	12,065
Somerset	--	1	--	--	--	--	1	8,636
Venango	142	--	2	--	--	2	146	115,108
Warren	143	1	3	1	--	1	149	135,491
Washington	--	1	3	--	--	--	4	2,734
Westmoreland	--	7	1	--	--	--	8	21,265
Wyoming	--	1	--	--	--	1	2	5,799
Total	393	196	30	1	3	18	641	1,156,273

[1] Development wells as defined by American Petroleum Institute.

Source: American Petroleum Institute.

The Montour, Conemaugh, Homer City, and Keystone stations will consume about 500 million tons of coal during their anticipated 30-year lifetime. This supply of coal will be mined in the Chestnut Ridge area, which reportedly contains more than 12 billion tons of bituminous coal reserves. Mines under contract to produce coal for the four stations are operated by the Florence Mining Co., the Greenwich Collieries Co., the Helen Mining Co., and the Oneida Mining Co., an affiliate of the North American Coal Co.

Ground was broken in midyear for a $350 million coal-fueled electric generating station on the Ohio River near Shippingport. The new Bruce Mansfield plant will have two 880-MW generating units, of which the first is expected to be in operation in 1975 and the second in 1976. The North American Coal Corp. signed a contract in October calling for annual shipments of 4.3 to 5.2 million tons of coal beginning in 1974 from reserves in southern Ohio. In November, the Central Area Power Coordination Group (CAPCO), which will own the plant, announced plans for a third coal-fueled unit at the plant. This unit is scheduled for completion about 1980. CAPCO members comprise the Ohio Edison Co., the Pennsylvania Power Co., the Duquesne Light Co., the Toledo Edison Co., and the Cleveland Electric Illuminating Co. The first two companies will build and operate the plant.

On September 26, the Duquesne Light Co. announced plans to build a second 847-MW nuclear powerplant at Shippingport. Westinghouse Electric Corp. will supply the turbine generator, reactor, and nuclear fuel for the plant. Construction is scheduled to start in 1973, and the plant is to be in service by 1978. Duquesne Light Co. will operate the plant, which will be jointly owned by five members of CAPCO. The plant will be the third nuclear plant at Shippingport, where a similar 847-MW station was under construction and was expected to start operation in 1973. The original Shippingport plant, a 30-MW station, began operation in 1957 and was enlarged to a 90-MW capacity in 1967.

Philadelphia Electric Co.'s 90–MW prototype helium-cooled No. 1 unit at the Peach Bottom generating station completed its fourth year of commercial operation. Work proceeded on two additional nuclear units under construction at Peach Bottom. By yearend, Unit No. 2 was about 85 percent complete and Unit No. 3 was about one-half complete. Each unit will consist of a boiling water reactor and a 1,065-MW turbine generator, the first scheduled for commercial operation early in 1973 and the second a year later. The company solely will be responsible for the operation of the two units, although their ownership and output will be shared by three other electric utilities.

Electric utility plants in 1971 received 1,670,000 tons of anthracite and 30,331,000 tons of bituminous coal. These plants consumed 32,238,568 total tons of anthracite and bituminous coal, 26,286,865 42-gallon barrels of oil, and 9,747,916,000 cubic feet of gas for producing 87,361,121,000 kilowatt-hours of electricity. Hydropowered generation produced 771,007,000 kilowatt-hours of electricity.

NONMETALS

Cement.—Portland cement shipments from 20 plants in eight counties were 2 percent greater in quantity than in 1970, and 16 percent greater in value because of an average increase of 40 cents per 376-pound barrel. Masonry cement shipments from 15 plants in eight counties were 7 percent greater in quantity than in 1970, and 35.1 percent greater in value because of an average value increase of 79 cents per 280-pound barrel.

Eighteen of the 20 producing plants owned 56 kilns collectively capable of producing 47,282,000 376-pound barrels of clinker on a 11-operating-month basis. Two of the plants performed grinding only. Raw materials used by the 18 producing plants comprised 4,236,367 short tons of limestone, 7,213,312 tons of cement rock, and 1,439,757 tons of clay, shale, bauxite, sand, gypsum, blast furnace slag, iron ore, and mill scale. The State's cement industry used 40 million cubic feet of natural gas, 478,000 42-gallon barrels of fuel oils, 1,672,000 tons of bituminous coal, 46,000 tons of anthracite, and 1,149,079,000 kilowatt-hours of electrical energy, of which 97.9 percent was purchased.

Of the total portland cement shipped, 90.3 percent was Type I and II (general use and moderate heat) and the remainder was Type III, comprising high-early-

strength, white, slag-pozzolan, block, and expansive.

Northampton and Lawrence Counties collectively accounted for 61 percent of the total portland cement shipments and 56 percent of the total masonry cement shipments.

The Medusa, Coplay, Louisville and Lone Star companies were the leading producers of portland cement. The Coplay, Louisville, Penn-Dixie, and Keystone companies were the largest producers of masonry cement.

For the purpose of cement surveys Pennsylvania is divided into western and eastern producing districts, which are separated by the eastern boundaries of Potter, Clinton, Centre, Huntingdon, and Franklin Counties. The five plants in the western district shipped 10,943,740 barrels of all types of portland cement at an average value of $3.21 per 376-pound barrel, an 8-cent increase above the 1970 value; and 1,058,754 barrels of all types of masonry cements at an average value of $3.63 per 280-pound barrel, a 71-cent increase above the 1970 value. No white cement was produced in the western district, although some was received from the eastern district.

The 15 plants in the eastern district shipped 30,809,027 barrels of all types of portland cement at an average value of $3.42 per 376-pound barrel, 52 cents more than in 1970; and 1,934,892 barrels of all types of masonry cement at an average value of $3.83 per 280-pound barrel, an 84-cent increase above the 1970 value. White cement was produced by two plants in the eastern district.

The distribution by use in percent of the portland cement shipped was as follows:

	Shipping district	
Use	*Western*	*Eastern*
Ready-mixed concrete	62.2	50.7
Concrete products	14.3	21.9
Building materials vendors	7.2	20.3
Highways	14.1	6.2
Contractors and other uses	2.2	0.9

The destinations and methods of shipments of portland cement only on the basis of 376-pound barrels were as follows:

	Bulk	*Container*
Destination;		
Terminal to consumers	4,111,536	234,765
Plants to consumers	32,337,595	5,068,871
Total	36,449,131	5,303,636
Transport method;		
Railroad	6,203,231	828,713
Truck	30,245,278	4,473,273
Other	622	1,650
Total	36,449,131	5,303,636

The total consumption of portland and masonry cements in the State totaled 6,323,000 barrels in the western district and 11,736,000 barrels in the eastern district.

Yearend stocks of portland cement were 1,645,000 barrels in the western district and 1,827,000 barrels in the eastern district.

Air cleaning systems were installed on the blending and storage silos, and additional gas cleaning equipment was being installed on the kilns in the Penn Hills Borough plant of the Universal Atlas Cement Co.

The Whitehall Cement Manufacturing Co., at its Whitehall, Pa. plant, started the installation of a glass-fiber baghouse to replace the electrostatic precipitator installed on the preheater kiln in 1956.

Clays.—Excluding kaolin, the total production of all other clays and shales was 12.8 percent less in tonnage and 44 percent less in value than in 1970. The average value per short ton decreased to $3.84 from $5.94 in 1970. The clay industry operated 88 mines in 28 counties. Production and value data excluding confidential data for kaolin are shown:

Type of clay	Producing counties	Production (1,000 short tons)	Value (thousands)	Average value per short ton
Common clay	12	567	$1,690	$2.98
Shale	19	1,098	2,749	2.50
Undifferentiated clay and shale	1	101	328	3.25
Fire clay	11	559	4,173	7.47
Total	--	2,325	8,940	3.85

Jefferson and Lawrence Counties produced 61 percent of the common clay; Lawrence, Clearfield, Armstrong, Jefferson, Berks, and York Counties produced 51 percent of the shale; Chester County produced all of the undifferentiated clay and shale; and Armstrong, Clearfield, Fayette, and Somerset Counties produced 93 percent of the fire clay.

Kaolin was produced at three mines operated by three companies in Clinton, Cumberland, and Lancaster Counties. Compared with 1970, the total kaolin production was 55 percent greater and its average value per short ton increased 70 percent.

Table 12.—Clays sold or used by producers, by use [1]

(Thousand short tons)

Use	1970	1971
Building brick	1,475	1,358
Firebrick and block	645	498
Vitrified sewer pipe	W	132
Drain tile	25	24
Mortar	2	3
Other uses [2]	518	310
Total	2,665	2,325

W Withheld to avoid disclosing individual company confidential data.

[1] Excludes kaolin; includes common clay and fire clay.

[2] Includes foundries and steelworks, high-alumina brick (1971), other refractories (1971), floor and wall tile, cement, pottery, lightweight aggregate, and other uses.

Diamond, Synthetic.—On November 16, 1971, E. I. du Pont de Nemours & Co., Wilmington, Del., reportedly exploded 7 tons of explosives in a 50-foot deep borehole charged with unidentified chemicals. The operation, in an uninhabited area west of Shamokin, Pa., was a test to determine the feasibility of a technique designed to produce synthetic diamonds. Full data were not released by Dupont officials, who stated the test results were being evaluated.

Gem Stones.—Minerals collected in early 1971 at the Cedar Hill serpentinite quarry at Talmage in Lancaster County included huntite (magnesium-calcium carbonate), penninite (a member of the chlorite family), tan crystals of zircon, white crystals of fluorapatite, and grains of magnetite. The rare hydrous nickel arsenate (erythite) and cobalt arsenic sulfide (cobalite) were found in Triassic sediments near a diabase.

Unusual minerals found in the Showalter quarry near Blue Ball in Lancaster County included pale-yellow celestite, pale-blue celestite, blue and purple fluorite, calciostrontianite, pink calcite, flesh-colored dolomite, and rutile.

Chrysocolla was found near Hummelstown, uranium silicate (coffinite) and rare-earth silicate (chevkinite) were found near Bethlehem, magnetite crystals were found in Mud Lake limonite pits, and pumpellyite, a complex alumino silicate of calcium, magnesium, and iron, was found in the Bunker Hill volcanics near Jonestown, in Lebanon County.

Minerals found near Shenandoah Heights, Schuylkill County, at the Kehley Run mine, a burning anthracite strip mine, included native sulfur, ammonium chloride (salammoniac), crytohalite and bararite (both of which are forms of ammonium silicon fluoride), mascagnite (ammonium sulfate), galena, kaolinite, quartz, and hematite.

The quartz crystal locality at Kunkletown, Monroe County, was again opened to mineral collectors, who obtained permission to enter the site from the Universal Atlas Cement Co., P.O. Box 29, Northampton, Pa. Fee collecting areas included the Cedar Hill Quarry, Route 1, Lancaster, Pa., and the Kibblehouse Quarry at Perkiomenville.

Native selenium was discovered in July 1971 in Luzerne and Dauphin Counties. The mineral occured as black metallic hexagonal crystals, many of which were in the form of hollow tubes, metallic hairs, and gray metallic balls of amorphous selenium mixed with sulfur and enclosed by crystals of cryptohalite. The selenium was formed by sublimation under the artificially induced fumarolic conditions of burning anthracite beds and culm banks.

Glass.—Pittsburgh Plate Glass Industries (PPG) with manufacturing facilities at Creighton, Ford City, Greensburg, Meadville, and Tipton, began construction on November 24, of the first of two float glass melting furnaces and the installation of related equipment at Mt. Holly Springs in Cumberland County. The first float glass production was expected in April 1972, with full production in mid-1972. The $50 million facility will employ 800 persons and will be capable of producing about 200 million square feet of float glass

per year. The Mt. Holly float glass units, the fifth and sixth operated by PPG, will mark the nearly complete conversion by the firm from the plate glass to the float glass process.

In mid-December, the Anchor Hocking Corp., at its Connellsville plant, produced nearly one-half million amber-colored bottles during a 30-hour trial run. The trial run used the firm's own raw material to which was added 10 tons of a glass product extracted by the Bureau of Mines from the residue of a refuse incinerator in Alexandria, Va. The firm reported that the residue glass did not affect the strength or durability of the bottles, although they did have visual flaws because of a trace of slag left on the residual glass during incineration. The trial run culminated 1 year of preparatory effort by the Bureau and the corporation in the fields of environmental improvement and conservation of national resources.

The General Electric Co., at Bridgeville, installed a baghouse at its glass furnaces to reduce the emission of lead from 28 pounds per hour to less than 0.1 pound per hour.

Graphite.—Synthetic graphite powders and shapes were produced by two companies in St. Marys and one company in Easton. The output, in the form of anodes, electrodes, crucibles and vessels, cloth, fibers and motor brushes and brush stock, and miscellaneous items, was produced from raw materials including petroleum coke, lamp black, pitch cokes, black oil, and gaseous hydrocarbons. Compared with 1970, the quantity of production was 1.7 percent less and its value was 2.2 percent less.

The development of a radically new form of graphite was achieved in the laboratories of Pfizer–Minerals, Pigments and Metals Division, Easton, Pa. Scientists in the laboratories produced graphite in the form of a flat sheet or continuous ribbon only 0.0003 inch thick. The new material was strong and stiff in all directions, it was lighter than aluminum, and it withstood temperatures above 5,000°F.

Gypsum.—Gypsum was calcined by the United States Gypsum Co. in Philadelphia County. The production was estimated to have been 0.5 percent more and its value 0.4 percent greater than in 1970.

Lime.—Nine companies in nine counties operated 11 plants, of which seven sold or used both quick and hydrated lime and four produced quicklime only. The total production of quicklime and hydrated lime decreased 6.7 percent in tonnage but increased 2.5 percent in value compared with the 1970 figures. The average value of all production increased from $15.52 per ton in 1970 to $17.05 per ton in 1971. The average value of quicklime increased from $15.19 to $16.47 per ton, and that of hydrated lime increased from $17.09 to $19.56 per ton. The steel industry consumed most of the total production. The remainder of the production was distributed among refractories, construction, water and sewage treatment, paper, agricultural, and other uses. Of the total lime sold or used, approximately 70 percent was consumed in Pennsylvania. New Jersey accounted for 5 percent and other States 25 percent. Centre

Table 13.—Lime sold or used by producers, by use

(Short tons)

Use	1970		1971	
	Quantity	Value	Quantity	Value
Steel, BOF	771,292	$11,355,774	732,469	$11,607,437
Steel, open-hearth	234,922	3,196,740	W	W
Water purification	90,205	1,361,479	134,276	2,380,343
Construction	116,870	1,987,000	125,159	2,428,938
Steel, electric	119,896	1,670,100	95,533	1,449,320
Sewage	85,784	1,490,800	70,652	1,254,383
Paper and pulp	75,422	1,039,400	42,248	664,190
Agriculture	66,055	1,066,710	20,161	341,111
Tanning	8,956	141,100	9,933	178,700
Other uses [1]	317,110	5,970,184	529,666	9,703,332
Total	1,886,512	29,279,287	1,760,097	30,007,754

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."

[1] Includes refractory dolomite, other chemicals, acid mine water neutralization, (1971), chrome (1971), other metallurgy, insecticides, magnesite (1971), silica brick, ore concentration, sand-lime brick, wire drawing, sugar refining, food, paint, petroleum refining, glass (1970), alkalies, and uses indicated by symbol W.

County led in production with three large plants, each of which produced quicklime and hydrated lime. Leading producing companies were Bethlehem Mines Corp., Warner Company, and Standard Lime & Refractories Co.

Through December 1971, the lime plant of the Bethlehem Mines Corp., Annville, Pa., had operated during a record 2.24 million man-hours without a disabling injury.

Mica.—Residual crude mica occurring as a deposit in schist was mined and processed using dry grinding by the Micalith Mining Co., Inc., at its Hokes mine near Glenville in York County. The air-separated mica was used in paints, roofing, greases, electrically insulated welding rods, and rubber and textile coatings. The demand for roofing mica decreased because of the greater use of higher density talc and sand in roofing formulations.

Compared with 1970, the quantity and value of mica sold by the single producer were substantially less. The State was eighth in the national production of mica.

A muscovite mine was being developed on Pequea Creek near Lancaster. Drilling and trenching was performed in 1970, and drill holes were extended to 250 feet in 1971. The 77-acre property reportedly contained 35 million tons of fine flake mica, which, after wet grinding, reportedly could be sold for $175 per ton.

Mullite.—The Remmey Division of A. P. Green Refractory Co., in Philadelphia, produced synthetic mullite that was 23.1 percent greater in quantity and 47 percent greater in value than in 1970.

Perlite.—Crude perlite was shipped into the State and expanded in nine plants operated by seven companies in eight counties.

Compared with 1970, the total quantity sold or used by seven reporting companies was 27 percent greater and its total value was 23 percent more. The average price in 1971 was $55.32 per short ton compared with $55.98 in 1970. Expanded perlite was sold or used chiefly for building plaster, with other uses being loose fill insulation, concrete aggregate, filler, soil conditioning, filter, cryogenic applications, charbase, refractories, castable insulation, bonding mortar, fire extinguishing powder, a carrier for pesticides, and oil absorbent.

Pyrites.—The State's production and value of pyritic concentrates were second in national rank. The pyritic concentrates were produced at the magnetic-iron-ore beneficiating plants at the Grace and Cornwall underground mines of the Bethlehem Steel Corp. in Lebanon and Berks Counties.

Some of the Cornwall plant's output was a chalcopyrite concentrate from which copper, gold, and silver were recovered by a midwestern smelter. The larger portion of the pyritic concentrates production was shipped to the corporation's Sparrows Point, Md., steelworks. There, the sulfur content was converted into sulfuric acid and the residual iron oxides were processed to recover copper and cobalt as a concentrated sulfate solution. The extracted iron oxides were sintered and used as portion of the raw materials charged into the blast furnaces at Sparrows Point, Md.

Shipments of all concentrates averaged 47.7 percent sulfur content and were 4.7 percent more in quantity and 6.1 percent more in value than in 1970.

Quartz Crystal.—The P. R. Hoffman Co. in Carlisle synthesized quartz crystals for its own uses and for sale to other quartz crystal cutters. The quartz crystals were grown in autoclaves at pressures in the range of 1,500 to 20,000 pounds per square inch at temperatures ranging from 250° to 450° C, using soda ash solution as the process solvent and Brazilian lasca and defective quartz crystals as the nutrient material. The growth of crystals occurred on natural or manufactured quartz seed plates in a predetermined crystallographic plane. Pennsylvania was one of the large producers of cut quartz crystals for the electronic industry.

Sand and Gravel.—Commercial operators used 70 stationary plants, 18 portable plants, and 10 dredges to produce sand and gravel. The quantities of sand and gravel in million tons transported from the producing operations comprised 16.40 by truck, 0.56 by railroad, and 2.70 by waterway. Leading producing counties were Bucks, Beaver, Erie, Westmoreland, Luzerne, and Wyoming.

Compared with the 1970 situation, the total production of sand and gravel increased 6.3 percent, and its value increased 6.6 percent because of a 0.6-cent-per-ton average increase in value.

The total sand production in 1971 was 2.6 percent greater and its value was 5.3 percent greater owing to a 5.2-cent-per-ton average increase in value. Sand used for building and paving purposes decreased 6.7 percent in tonnage but increased 14.7 cents per ton in value in 1971. Ground and unground sands for industrial uses classed as molding, fire and furnace, glass, grinding and polishing, blast, engine, filtration, hydrofrac, enamel, fillers, foundry, pottery, and miscellaneous totaled 3,211,000 short tons and were valued at $7,727,000, compared with 2,328,000 tons valued at $6,491,000 in 1970. The average value of all industrial sands was 43.8 cents per ton less than in 1970.

The total production of gravel increased 11.1 percent, although its value was only 8.5 percent greater than in 1970 because of a 4.1-cent-per-ton average decrease in value. All but 10 percent of the total gravel production was used for construction purposes.

Based on the total production of all sand and gravel, sand in 1971 accounted for 54.3 percent of the total tonnage and 58.2 percent of the total value compared with 56.2 percent of the total tonnage and 58.9 percent of the total value in 1970.

In the 1971 National Sand and Gravel Association safety contest, covering the period from July 1, 1970, to June 30, 1971, Pennsylvania had three plants reporting no accidents. The companies and their plants awarded the Certificate of Achievement in Safety were Appalachian Stone Div., Martin Marietta Corp., Mercersburg, Milton and Burlington plants; George R. Pettinos, Inc., Bala Cynwyd, New Freedom plant.

Stone.—Pennsylvania was the country's leading stone producer. Major stone producing counties, accounting for 51 percent of the total product and 55 percent of the total value, were Northampton, Montgomery, Bucks, Lancaster, Adams, York, and Berks.

Total production was 2.5 percent less, and its value was 1.4 percent lower than in 1970 despite a 2.3 cent-per-ton average increase in value.

Dimension stone produced at 32 operations in nine counties accounted for 1.6 percent of the total stone production and 4.5 percent of its total value. The average value per short ton of all dimension stone increased to $49.20 from $48.19 in 1970. The number of companies producing dimension stone by type was as follows: Sandstone, 15; slate, eight; granite, two; other stone, two; and traprock, two. Dimension quartzite, sandstone, traprock (basalt), and other stone were used primarily for irregular shapes and sawed stone; granite for rubble; and slate for blackboard and flagging. Slate accounted

Table 14.—Sand and gravel sold or used by producers, by class of operation and use

(Thousand short tons and thousand dollars)

Class of operation and use	1970		1971	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	4,700	$7,749	4,651	$8,352
Fill	85	113	135	250
Fire or furnace	36	123	W	W
Molding	102	401	W	W
Paving	3,158	5,088	2,678	4,700
Other uses [1]	2,328	6,491	3,211	7,727
Total [2]	10,409	19,965	10,675	21,029
Gravel:				
Building	3,501	5,897	4,330	6,874
Fill	W	W	768	1,001
Miscellaneous	3,531	6,523	2,994	6,141
Paving	127	195	W	W
Other uses [3]	935	1,335	902	1,118
Total [2]	8,095	13,951	8,994	15,134
Total sand and gravel [2]	18,504	33,915	19,668	36,162

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."

[1] Includes glass, grinding and polishing, blast, engine filtration, oil (hydrofrac), ground, and other sands, and fill and fire or furnace sand in 1971.

[2] Data may not add to totals shown becuase of independent rounding.

[3] Includes railroad ballast (1970), fill (1970), miscellaneous, and other gravel.

for nearly 41 percent of the total production of dimension stone and 76 percent of its total value.

Crushed and broken stone produced at 201 operations in 47 counties equaled 98.4 percent of the total stone production and 95.5 percent of its total value. The average value of crushed and broken stone increased to $1.76 per short ton from $1.73 in 1970. The number of operations producing crushed and broken stone was as follows: Limestone, 144; sandstone, 26; traprock, 13; quartzite, eight; other stone, six; dolomite, two; slate and granite, one each.

In crushed and broken form, the major use of granite, limestone, quartzite, sandstone, traprock, and other stone was for road aggregates and road base stone. The major use of dolomite was for calcined products. Crushed and broken limestone accounted for about 82 percent of the production and 80 percent of the value of the total crushed and broken stone production. The distribution of the total crushed and broken limestone production by percent and uses follows: Road aggregates and road base stone 62.5; cement manufacture, 20.7; flux stone, 7.2; lime manufacture, 3.0; agricultural uses, 2.8; and 18 minor uses, 3.8. The types of transportation and the approximate percentages of crushed and broken limestone moved were truck, 81.5; railroads, 8.9; waterway, 0.4; and other methods, 9.2.

Four quarries prepared limestone suitable for mine dusting. The 1971 production

Table 15.—Stone sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1970			1971			Kind of stone produced in 1971
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value	
Allegheny	1	54	W	1	W	W	
Armstrong	5	249	$562	5	249	$525	Limestone.
Berks	13	3,863	5,659	11	4,018	5,475	Limestone, sandstone, traprock.
Blair	11	1,210	2,110	9	1,318	2,223	Limestone, quartzite.
Bucks	18	4,133	6,430	14	5,030	9,257	Limestone, sandstone, traprock, other stone.
Butler	5	1,738	4,680	5	1,623	3,679	Limestone.
Centre	9	3,278	5,974	8	2,710	4,810	Limestone, dolomite.
Chester	12	2,850	5,153	7	2,085	2,963	Sandstone, limestone, traprock.
Clarion	W	W	W	3	206	W	Limestone.
Cumberland	6	1,483	2,443	6	W	3,258	Do.
Dauphin	4	950	1,465	3	W	1,311	Limestone, sandstone.
Franklin	5	W	990	5	W	W	Sandstone, limestone.
Huntingdon	5	W	1,042	6	673	2,347	Limestone, quartzite.
Lancaster	15	4,317	7,685	15	4,968	9,177	Limestone.
Lawrence	5	2,881	3,895	4	2,387	3,465	Do.
Lebanon	4	1,039	1,801	2	W	W	Do.
Lehigh	10	2,663	3,951	7	1,756	3,149	Slate, limestone.
Luzerne	4	451	W	3	1,134	1,741	Sandstone.
McKean	1	W	W	1	39	W	Do.
Mifflin	4	286	380	3	W	W	Limestone.
Montgomery	16	5,277	9,377	14	5,574	10,050	Granite, sandstone, quartzite, traprock, other stone, limestone.
Northampton	20	5,826	10,637	20	6,433	11,538	Slate, limestone, quartzite.
Northumberland	3	306	498	3	235	520	Limestone, sandstone.
Potter	5	3	93	3	3	101	Sandstone.
Schuylkill	4	1,091	1,641	3	162	W	Limestone, sandstone, quartzite.
Somerset	5	564	1,593	4	457	1,225	Limestone, sandstone.
Susquehanna	8	W	606	7	W	553	Sandstone.
Venango	1	W	4	--	--	--	
Wayne	2	W	407	1	W	W	Sandstone.
Westmoreland	11	1,445	2,879	8	1,692	3,378	Limestone, sandstone, other stone.
York	11	4,025	9,312	10	3,488	7,988	Limestone, dolomite.
Undistributed [1]	48	16,259	28,923	42	18,228	29,736	
Total [2]	271	66,241	120,187	233	64,467	118,469	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes production for Adams, Bedford, Cambria, Carbon, Columbia, Delaware, Elk, Fayette, Fulton, Jefferson, Lycoming, Mercer (1971), Monroe, Montour, Perry, Snyder, Union, and Washington Counties, and data indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Table 16.—Stone sold or used by producers, by use
(Thousand short tons and thousand dollars)

Use	1970		1971	
	Quantity	Value	Quantity	Value
Dimension stone:				
Building stone	68	$1,432	55	$960
Curbing and flagging	25	758	24	637
Other uses [1]	29	3,688	29	3,718
Total [2]	122	5,879	108	5,314
Crushed and broken stone:				
Bituminous aggregate	4,276	7,709	6,048	11,019
Concrete aggregate	10,150	16,293	9,600	15,202
Dense graded road base stone	9,224	13,386	10,009	16,943
Macadam aggregate	1,667	2,549	1,340	2,254
Surface treatment aggregate	2,526	3,471	2,681	3,779
Unspecified aggregate & roadstone	13,481	22,102	12,689	20,985
Agricultural limestone	1,825	5,711	1,620	4,392
Filter stone [3]	670	1,342	271	500
Flux [4]	5,681	10,953	4,100	8,095
Railroad ballast	775	1,237	619	1,036
Refractory stone	252	1,732	199	2,498
Riprap and jetty stone	122	194	187	327
Other uses [5]	15,470	27,629	14,996	26,125
Total [2]	66,119	114,308	64,359	113,155
Grand total	66,241	120,187	64,467	118,469

[1] Includes monumental stone, roofing slate, millstock, and uses not listed or unspecified.
[2] Data may not add to totals shown because of independent rounding.
[3] Includes stone sand.
[4] Includes stone used in dead-burned dolomite.
[5] Includes stone used in cement and lime manufacture, chemicals, abrasives (1971), mine dusting, asphalt fill (1971), whiting, roofing aggregates, and other uses in smaller quantities.

totaled 238,955 short tons, 6.3 percent less than the 255,127-ton production in 1970.

Winners of safety honors in the eighth annual National Limestone Institute Safety Competition conducted by the U.S. Bureau of Mines were Faylor Lime & Stone Co., Dauphin County quarry, Winfield, and Mifflin County quarry, Winfield; David M. Burkholder, Inc., Ephrata quarry, Ephrata; Meckley's Limestone Products Co., Herndon mine, Herndon; and Sugar Hill Limestone Co., Sugar Hill quarry, Brockaway.

The Faylor Lime and Stone Co., near Shamokin, in April completed the installation of a stationary 250-ton-per-hour-capacity crushed stone plant, which included equipment for three crushing and two screening phases.

Special publications SR 70–3 and SR 70–4, released by the Pennsylvania State University's Experiment Station, described the results of the small industries research program on bluestone that was performed by the University and sponsored by the Pennsylvania Bluestone Association. Methods for improving the image of the Pennsylvania product were suggested, including establishment of industry-wide grades, use of a new trade name, and rigid quality control.

Sulfur.—Four petroleum refineries operated by four companies in Delaware and Philadelphia Counties used modified or improved Claus processes to produce 22,081 long tons of elemental sulfur (100-percent basis). Shipments totaling 20,769 long-tons (100-percent basis) were 18.5 percent greater than in 1970. However, the average value of shipments was $21.09 per long ton, compared with $26.32 per long ton in 1970. One of the four refineries shipped more than 93 percent of the hydrogen sulfide produced by a Girdler recovery system that used monoethanolamine as the absorbent medium.

Approximately three-fourths of the total sulfuric acid produced by the New Jersey Zinc Co. in Palmerton and St. Joseph Lead Co. in Josephtown was consumed by the producers.

Talc (Sericite-Schist).—For the first time in many years, no talc was produced by Summit Industries Inc., the State's sole talc producer, in Adams County.

Tripoli (Rottenstone).—Crude tripoli, mined and processed by two companies in Lycoming County, was 16 percent less in

quantity and 20 percent greater in average value per ton than in 1970. The material was prepared for use as a filler by one plant near Muncy. The other company, near Oriole, employed drying, crushing, and roller-mill grinding to produce abrasives and fillers. Pennsylvania ranked fourth in the list of U.S. producers in both quantity and value.

Vermiculite (Exfoliated).—Hyzer and Lewellen in Bucks County and W. R. Grace & Company in Lawrence County exfoliated vermiculite produced outside Pennsylvania. Approximately 88 percent of the production was sold, principally for loose fill insulation, concrete aggregates, and horticultural uses.

METALS

Aluminum.—In late March, the Aluminum Co. of America (Alcoa) culminated operations at its New Kensington works and sold the 80-year-old plant to the Schreiber Industrial Development Co. The operations phased out included those producing impact extrusions, powder, pigments, and other specialty products.

Beryllium.—Kawecki Berylco Industries, Inc. (KBI) produced Berylco CR–1, the casting version of KBI's beryllium-nickel alloy 440. The product reportedly eliminated the corrosion of oilfield parts exposed to fluids and gases. The age-hardenable material, which was usable up to 800° F, combined high hardness and wear resistance with good ductility.

At Reading, KBI installed two new Sendzimir mills designed to reduce materials to 0.001-inch thickness. Both mills had modern gage instrumentation controls and were designed for ultimate conversion to computer control. Because of the precipitation hardening behavior of beryllium copper, the mills were designed more for accuracy than speed. New slitters, heat treating furnaces, and pickling equipment were also installed to augment the new mills.

Carbides.—Kennametal Inc., in Latrobe, following six years of development work, perfected a new isostatic process that yielded cemented sintered carbides free of all surface pits and internal flaws. The process, code-named Keziz, used helium or argon at pressures as high as 20,000 pounds per square inch and sintering temperatures as high as 2,750° F. Two installations using the process on a 48-hour start-to-finish basis can produce 300,000 pounds per year of sintered carbide products.

Cobalt.—The quantity of cobalt produced was 1 percent less and its value was 18.1 percent less than in 1970. This cobalt, the only domestic source, was recovered by the flotation of separator tailings during the beneficiation of magnetic iron ore mined by the Bethlehem Steel Corp. from its Grace mine in Berks County and its Cornwall mine in Lebanon County. The ore from the Cornwall mine contained about two-thirds of the total recoverable cobalt.

The cobaltic pyrite concentrate, recovered near the two underground mines, were processed at the corporation's Sparrows Point, Md., steel plant to produce sulfuric acid. The resulting calcined iron residue was leached to recover cobalt and copper as a concentrated sulfate solution devoid of gold and silver. The concentrated solution was shipped to the Pyrites Co., Inc., Wilmington, Del., where it was processed to recover cobalt as metal, oxide, and hydrate, and copper chemicals.

Copper, Gold, and Silver.—Compared with 1970, the respective production of these metals was 32, 30, and 50 percent greater, and their respective value was 19, 49, and 27 percent greater. These metals were present in chalcopyrite concentrates produced during the flotation of iron ore from the Bethlehem Steel Corp. Cornwall mine in Lebanon County. The chalcopyrite concentrates containing 26.6 percent copper were shipped to a western smelter.

Iron Ore.—The Bethlehem Steel Corp. produced magnetic iron ores at the Grace underground mine in Berks County and at the Cornwall underground mine in Lebanon County. Explosives consumed at these mines comprised 362,600 pounds of dynamites and 1.49 million pounds of bagged and bulk ammonium nitrate mixed with fuel oil. Both mines used the block-caving mining method. All operations at the Cornwall Division will cease at the end of 1972. Two plants beneficiated the crude ore into a product that was pelletized prior to shipment to the corporation's iron and steel works. Pellet shipments were about 13 percent greater in quantity and about 18.7 percent greater in value than in 1970.

One chemical plant in Fayette County produced iron oxide clinker from pyritic roasting.

Iron Oxide Pigments.—Finished natural and manufactured iron oxide pigments were shipped from one plant in Allegheny County, from one plant in Carbon County, and from two plants in Northampton County. Compared with 1970, the shipments were 3.6 percent greater in tonnage and their value was 17.1 percent greater.

Iron and Steel.—The Armco Steel Corp., in Ambridge, contracted for a two-zone walking beam furnace capable of normalizing 30 tons per hour of pipe with outside diameter ranging from 2-3/8 inches to 14-3/8 inches. The design, engineering, and construction will be performed by Rust Furnace Co., a division of Litton Industries.

The Babcock & Wilcox Co. was expanding and modernizing cold finishing seamless tubing operations at its Beaver Falls plant. Production capacity will be increased about 20 percent. New equipment will include a 400,000-pound drawbench, five new cranes, two high-speed straighteners, one additional ultrasonic testing line, and two 150-foot furnaces. A $12 million pollution-control project was well underway by yearend at the plant. The company in November announced plans to install a major new specialty tube mill in buildings purchased from the Armco Steel Corp., in Ambridge. Although several miles away, the Ambridge plant will be an integral part of the firm's existing pipe and tube plants in Beaver Falls and Koppel, Pa.

Construction began on a $12 million, 16-month project to prevent air pollution at the Koppel and Wallace Run steel mills of the Tubular Products Division of the Babcock & Wilcox Co. in Beaver County. A total of five baghouses in the two mills will contain 10,300 dacron fiber bags, each 31 feet long. Dust and fume particles will be collected from a maximum of 2,360,000 cubic feet per minute of air. At the Koppel mill, a $750,000 air-cleaning device was in operation on an automatic scarfer and a $715,000 water-treatment facility was scheduled.

Bethlehem Steel Corp. began construction of a $5.5 million system to control dust emissions at its Bethlehem plant. The system, to be completed in the fall of 1972, will collect 8.5 tons per day of dust from the plant's electric furnaces. The dust will be pelletized and recycled as blast furnace feed.

The first unit of a new scrap preheater system, also the first in the industry, was placed into operation by midyear at the Steelton, Pa., plant of the Bethlehem Steel Corp. Specifications for the Steelton operation called for preheating scrap to 1,500° F. for a three-bucket charge to a 200-ton electric arc furnace.

The Bethlehem Steel Corp. rebuilt blast furnace E at its Johnstown plant. A helicopter, during 14 lifts performed in one-half day, carried away the old parts and raised the various new parts required in the work performed atop the 125-foot-high furnace. The corporation opened can-collection centers in Steelton and Bethlehem, where collections totaled 3.5 tons per week.

A strike that started October 8 kept workers idle through yearend at the Pittsburgh, Blawnox, Groveton, and Ellwood City, Pa. plants of the Blaw-Knox Co., a division of White Consolidated Industries.

The Carpenter Technology Corp., a special materials producer in Reading, began the operation of two 25-ton basic electroslag furnaces, each costing $300,000. Each furnace was rated at 3,000 tons per year. Ingots up to 16 feet long and 40 inches in diameter can be produced in the $2 million electroslag facilities.

The State's Justice Department and the Crucible Steel Corp. in April agreed on a proposal to begin reducing the pollutants discharged into the Ohio River by the company's Midland works. The agreement covered any pollutants from the company's coke plant, the discharge of acid rinse waters, and wastes from the cyanide treatment facilities at the company's blast furnace operation.

The Crucible Stainless Steel Division of Colt Industries announced plans to install a 100-ton argon-oxygen refining unit in its electric furnace shop in Midland. Full operation was predicted for early 1972.

In February, Jones & Laughlin Steel Corp. (J & L) awarded an $8 million contract to install two new electrostatic precipitators and to modify existing precipitators at the Aliquippa No. 2 BOF shop. The contract specified completion and op-

eration by June 22, 1972. The corporation developed a failsafe coke oven door removal system that sharply reduced the emission of smoke and dust while pushing coke from the ovens. The system was installed at the corporation's coke plants at Aliquippa and Pittsburgh.

Chemfix, a chemically oriented fixation process that in no more than 3 days turns industrial solids, liquids and sludges into a claylike solid suitable for landfill, was used to treat 100,000 gallons per day of liquid wastes at the J & L Hennepin works. The pollution-control process was developed by Environmental Sciences, Inc., based in Pittsburgh.

J & L closed the open hearths, blast furnaces, and ingot foundry at its Pittsburgh works on September 18 for an indefinite period. The corporation reported that it intended to sharply cut the work force in its integrated works in Pittsburgh where the ironmaking and steelmaking sections currently were idle. About 1,250 jobs were to be eliminated in the southside portion of the Pittsburgh works that contained the open hearth furnaces. However on December 30, it was announced that about 2,000 workers would be recalled at the Pittsburgh works by mid-January 1972, resulting in a total work force of about 5,500 employees. In early December, the corporation announced that the P–3 blast furnace would be relined as the first step in a revitalization project in the Pittsburgh works.

The Lukens Steel Co. installed a strand-casting machine for producing cast steel slabs and an electroslag-remelting furnace for refining steel. The casting machine, which started operation in January, set a new record in strand casting by producing a 157.5-ton steel slab, 12 inches thick, 85 inches wide, and 94 feet long.

The United States Steel Corp. (U.S. Steel) announced a major steelmaking expansion to be completed in 1972 at its Fairless works. The expansion will include two 200-ton-capacity electric furnaces, vacuum degassing facilities, a dual-strand continuous caster that will produce 230 tons per hour of 10-inch or 23-inch blooms, and two 5-zone pusher-type bloom reheating furnaces fueled by natural gas with fuel oil as standby. The installation of additional electrostatic precipitator capacity during 1971 at the Fairless works reduced the emission of particulates from the open hearth furnaces by about 40 tons per day. A company spokesman stated that it cost more than $1.50 to control air pollution for each ton of raw steel produced.

All steelmaking at the 2.0-million-ton-per-year-capacity Edgar Thomson works of U.S. Steel was temporarily halted on June 26. This action resulted in the layoff of about 2,000 workers from a total work force of 3,000. The works had eleven 225-ton-capacity open hearth furnaces not equipped with devices for smoke and fume removal, six blast furnaces, an ingot mold foundry, slab rolling facilities, and miscellaneous other departments. In July, the 2-million-ton-per-year capacity open hearth shop was removed from service. An adjacent new BOF plant with high energy venturi scrubbers was expected to commence operation in early 1972. Part of a dust collection system for two 220-ton basic oxygen vessels was being constructed in early 1971 at the Edgar Thomson works. Completion of the system was expected before yearend. The estimated reduction in particulate emissions due to this change in steelmaking was about 16,000 tons per year In late December, preparations began to reopen the Edgar Thomson works. It was estimated that 500 to 700 workers would return to the Braddock plant section of the works by mid-January 1972, boosting the total employment to between 1,500 and 2,100 workers, compared with nearly 3,000 workers a year earlier.

The corporation had the largest cutback in open hearths in 1971 when it closed a 3-million-ton-per-year shop at Braddock where in January 1972 it opened a basic-oxygen facility that has approximately the same capacity.

At the corporation's Duquesne 250,000-ton-per-year capacity electric furnace shop, facilities were being upgraded at a cost of $6 million to reduce particulate emissions by about 1,000 tons per year. The facilities were financed by the sale of industrial revenue bonds sponsored by the Allegheny County Industrial Development Authority. Rent paid on the facilities by the corporation will pay off the principal and interest on the bonds.

U.S. Steel also obtained approval of the Allegheny County Bureau of Air Pollution Control for an improved and enlarged electrostatic precipitator system for cleaning the waste gas from the 11 open hearth

furnaces at the Homestead works, all of which were equipped with oxygen lances. The corporation contracted for the installation of a fifth precipitator that will be tied into the same exhaust system used by four existing smaller capacity precipitators. Two new waste water treatment plants were in operation at the Homestead works by yearend.

In the West Mifflin plant of its Irvin works, U.S. Steel installed new facilities comprising one 84-inch, 5-stand cold reduction mill; one 84-inch continuous pickling line; 30 four-stack annealing furnaces; 60 fast cool bases; one 84-inch temper mill; and one 84-inch recoil line. The new equipment doubled the plant's capacity to 115,000 tons per month of cold-rolled sheets. The facilities, which could create 300 to 350 additional jobs, were the largest industrial project in western Pennsylvania's history.

The Washington Steel Corp., at Washington, Pa., built a plant to treat and purify water from the pickling and cleaning operations of the cold metal division. The firm also invested about $2.5 million in a new automated processing line for stainless steel sheet.

The third phase of a $325,000 antipollution control system was completed by the Sinking Spring Foundry Division of Hofmann Industries, Inc. The system was designed to reduce smoke discharged by 95 percent, reduce odors in the immediate neighborhood, and result in only 1 percent of the water used by the foundry being discharged into the area's sanitary sewer system.

A $500,000 baghouse was being installed in the Tullytown, Pa., plant of the Warner Co. The installation will be the first in the blast furnace slag processing industry. The company was also installing a 3-stage water-spray dust-suppression system for use with aggregate processing equipment.

Depressed demand for steel resulted in closedowns on November 20 of steelmaking at the Monessen works of the Wheeling-Pittsburgh Steel Corp., and at the corporation's hot-strip mill at Allenport. The closedowns idled 1,325 workers.

The Lehigh Univeristy established the Institute for Metal Forming for undergraduate and postgraduate research and education. The Institute will provide the teaching of the principles and applications of metal forming technology and will assist the industry with its metal forming problems.

Five plants of United States Steel Corp. were among the award winners in the National Safety Council's metal section 1970 annual contest. Plants winning first place awards were the Johnstown works and the Christy Park works. In all, United States Steel received 10 first place awards in the various categories. Second place awards were won by the Homestead works, the National-Duquesne works, and the American Bridge division's Shiffler plant in Lawrenceville. American Bridge's Ambridge plant won a third place.

As of January 1, there were 90 iron and steel establishments in the State, including 14 that were classed as producers of raw iron and steel and that were operated by eight companies.

According to the American Iron and Steel Institute, raw steel production was 27,655,000 short tons compared with 30,031,000 tons in 1970. The blast furnace production of pig and silvery irons, ferromanganese, and spiegel totaled 18,786,000 tons, 9.6 percent less than in 1970. This total production was classed as 93 percent basic, 4 percent Bessemer, and 3 percent malleable and foundry. Blast furnace production of ferromanganese and spiegel accounted for 362,000 short tons of the total tonnage, compared with 395,000 tons in 1970.

Of the 20,128,825 tons of ores and concentrates consumed (excluding agglomerates), agglomerating plants processed 50.3 percent, blast furnaces consumed 46.1 percent, and steel furnaces consumed 3.6 percent.

Receipts of iron ores, including 171,047 tons of manganiferous ores, totaled 22,888,045 tons, of which 37.5 percent came from U.S. sources and the remainder from foreign countries. Iron ores in stock totaled 9,814,113 tons on January 1 and 10,875,790 tons at yearend.

Agglomerating plants consumed 10,128,399 tons of iron ores, 909,159 tons of limestone, 1,121,764 tons of dolomite, 118,273 tons of other fluxes, 803,615 tons of mill cinder and roll scale, 810,660 tons of raw flue dust, 249,142 tons of steel furnace slags, 610,289 tons of coke breeze, and 194,305 tons of anthracite.

Active blast furnaces numbered 33 on January 1 and 26 at yearend. Idle blast furnaces totaled 22 on January 1 and 29 at yearend. Solids charged into blast furnaces comprised 9,248,153 short tons of iron ores, 3,323,751 tons of regular sinter, 9,593,780 tons of semi- and self-fluxing sinter, 4,610,986 tons of regular iron ore pellets, 2,271,576 tons of agglomerates from foreign countries, 710,287 tons of limestone, 1,580,504 tons of dolomite, 154,719 tons of other fluxes, 399,849 tons of mill cinder and roll scale, 943,974 tons of steel furnace slags, 11,775,176 tons of breeze-free coke, 15,138 tons of coke breeze, 18,097 tons of pig iron, 844,271 tons of home and purchased scrap, 92,959 tons of slag scrap, and 245 tons of alloys and miscellaneous solids. Blast furnaces produced 143,356 tons of scrap, 5,275,213 tons of slag, and 539,789 tons of flue dust. The average consumption of blast furnace coke per ton of hot metal produced was 1,254 pounds, identical to the National average. Supplemental fuels injected into blast furnaces through tuyeres comprised 3,769 million cubic feet of natural gas, 535 million cubic feet of coke oven gas, 20,232,583 gallons of bunker C oil, 17,194,360 gallons of No. 6 oil, and 4,929,905 gallons of crude coal tar.

Open hearth, BOF, and Bessemer steel furnaces consumed 716,273 tons of iron ores, 371 tons of semi- and self-fluxing sinter, 35,141 tons of regular iron ore pellets, 114,931 tons of agglomerates from foreign countries, 485,363 tons of limestone, 674,763 tons of burnt lime, 428,566 tons of dolomite, 79,049 tons of fluorspar, 223,442 tons of other fluxes, 144,342 tons of mill cinder and roll scale, 1,298 tons of anthracite, 7,979,173 tons of pig iron and hot metal, 9,428,583 tons of home and purchased scrap, 90,863 tons of slag scrap, and 79,119 tons of other scrap.

Molybdenum.—Molybdenum concentrates originating at its mill in Questa, Colo., were processed by the Molybdenum Corp. of America in Washington, Pa.

Nuclear Fuels.—The Babcock & Wilcox Co., announced in November that it was entering the plutonium fuel business following the purchase of the Nuclear Materials and Equipment Corp. operations from the Atlantic Richfield Co. Acquired in the purchase were a plutonium plant and a special metals plant in Leechburg and a uranium plant in Apollo. Both plants were in Armstrong County.

The Westinghouse Electric Corp. dedicated a $10 million, 350,000-square-foot nuclear center in Monroeville in midyear. About 1,800 persons eventually will be employed in the development, design, engineering, and sale of pressurized water reactor nuclear-fueled electricity generating systems.

In June, CNA Nuclear announced an agreement with the Duquesne Light Co., the Ohio Edison Co., and the Pennsylvania Power Co. to lease fuel for the first 847-megawatt plant under construction at Shippingport. The lease initially was for a $24.7 million core, although the actual value may change, owing to escalation and other factors, and could reach $30 million. The lease was written for 1 year, with month-to-month renewal provisions.

Platinum.—Matthey Bishop, Inc., at West Whiteland, produced platinum sheet, wire and tubing, oxidation gauze, melting pots for laser materials, laboratory ware, fume-abatement equipment, and hydrogen purifiers.

Rare Earths.—The Molybdenum Corp. of America in its 45,000-square-foot plant at York processed raw materials obtained from its mines in Mountain Pass, Calif., and Questa, Colo., and purchased from other sources. The plant's 29 hourly workers primarily produced rare-earth chloride and nitrate, cerium oxide, chemical products of molybdenum, ammonium and sodium tungstates, and tungsten oxide.

Tantalum.—Kawecki Berylco Industries, Inc. (KBI) developed new types of tantalum capacitor powders that featured up to 8,000 microfarad volts capacitance per gram. The new powders were used in radio transmission equipment, industrial instrumentation, electric watches, and hearing aids. KBI at Boyerstown produced tantalum and columbium alloys in strip, foil, and sheet forms.

Titanium.—Crucible, Inc., a division of Colt Industries, at Midland, produced titanium ingot from sponge metal and scrap.

Dynamet, Inc., ohtained a $52,000 loan from the Pennsylvania Industrial Development Authority for a new 9,600-square-foot building in Washington, Pa. The facility will produce titanium wire, and its 14 employees will have a $100,000 annual payroll.

Zinc.—Zinc ore, principally sphalerite, was mined and concentrated near Center Valley in Lehigh County. The concentrate was shipped to a vertical-retort smelter in Palmerton, where anthracite was used in the sintering operation. The smelter's products included rolled zinc, slab zinc, zinc die-casting alloys, dry battery shells, zinc oxide, spiegeleisen, cadmium, and sulfuric acid.

The mine output of zinc was 7.2 percent less and the value of production was 2.5 percent less than in 1970.

In October, the Waelz sinter plant started operating baghouse equipment costing $236,000 and capable of collecting up to 3 tons per hour of zinc oxide particulates, which were reprocessed. The insulated system prevented moisture condensation that normally results in clogging and rapid deterioration of bags.

A 40,000-ton-per-year plant was under construction at Palmerton, to produce ammonia from natural gas to supplement an existing 35,000-ton-per-year facility.

Zinc concentrates from the St. Joe Mineral Corp. Balmat-Edwards mining complex in northern New York were processed at the corporation's Josephtown electrothermic smelter at Monaca. The smelter has an annual capacity of 210,000 tons of slab zinc and 35,000 tons of zinc oxide.

Pennsylvania State University geologists released a description of lead and zinc deposits occurring as small veins in an exposure of the Tuscarora quartzite near Mapleton, in Huntingdon County, which may amount to commercially minable quantities. A favorable zone with high values of lead, zinc, silver, and other metals in soils, waters, and streambeds, was outlined by three mineralized occurrences at least 12 miles long.

Table 17.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives:			
Nonmetallic: Satellite Alloy Corp.	9800 McKnight Rd. Pittsburgh, Pa. 15237	Plant	Allegheny.
Metallic:			
Abrasive Metals Co	26th & B. & O. RR Pittsburgh, Pa. 15222	do	Do.
Durasteel Abrasive Co	2601 Smallman St. Pittsburgh, Pa. 15222	do	Westmoreland.
Industeel Corp	37th & A. V. RR Pittsburgh, Pa. 15222	do	Allegheny.
Pangborn Div., the Carborundum Co.	P.O. Box 380 Hagerstown, Md. 21740	do	Butler.
Cement:			
Allentown Portland Cement Co., Div. National Gypsum Co.[1]	7th St. at Thruway Allentown, Pa. 18101	do	Berks.
Allentown Portland Cement Co., Div. National Gypsum Co.	do	do	Montgomery.
Bessemer Cement Co., subsidiary of Louisville Cement Co.	510 Hanna Bldg. Cleveland, Ohio 44115	do	Lawrence.
Coplay Cement Manufacturing Co.[1]	North 2d St. Coplay, Pa. 18037	do	Lehigh.
Do	Easton Rd. Coplay, Pa. 18037	do	Northampton.
Dragon Cement Co., Div. of Martin-Marietta Corp.[1]	5A Joyce Kilmer Ave. New Brunswick, N.J. 08903	do	Do.
Green Bag Cement Co., Div. of Marquette Cement Manufacturing Co.	20 North Wacker Dr. Chicago, Ill. 60606	do	Allegheny.
Hercules Cement Co., Div. of American Cement Corp.[1]	555 City Line Ave. Bala-Cynwyd, Pa. 19004	do	Northampton.
Keystone Portland Cement Co.[1]	2200 Hamilton St. Allentown, Pa. 18105	do	Do.
Lone Star Cement Corp.[1]	P.O. Box 6237 West End Br. Richmond, Va. 23230	do	Do.
Medusa Portland Cement Co.[2]	P.O. Box 5668 Cleveland, Ohio 44101	do	Lawrence.
Medusa Portland Cement Co.[3 4]	do	do	York.
National Portland Cement Co.[1]	1023 West St. George Ave. Linden, N.J. 07036	do	Northampton.
Penn-Dixie Cement Corp.[5]	P.O. Box 152 Nazareth, Pa. 18064	do	Butler.
Penn-Dixie Cement Corp.[1]	do	do	Northampton.
Universal Atlas Cement Div., U.S. Steel Corp.	600 Grant St. U.S. Steel Bldg. Pittsburgh, Pa. 15230	do	Allegheny.

See footnotes at end of table.

Table 17.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Cement—Continued			
Universal Atlas Cement Div., U.S. Steel Corp.[1]	600 Grant St. U.S. Steel Bldg. Pittsburgh, Pa. 15320	Plant	Northampton.
The Whitehall Cement Manufacturing Co.[1]	123 South Broad St. Philadelphia, Pa. 19109	----do	Lehigh.
Clay and shale:			
Fire:			
Drexel Refractories Div., Drexel Dynamics Corp.	P.O. Box 50 Kittanning, Pa. 16201	Underground	Armstrong.
Freeport Brick Co	Drawer F Freeport, Pa. 16229	----do	Do.
Freeport Brick Co., Kittanning Brick Div.	R.D. 1 Adrian, Pa. 16120	----do	Do.
Hanley Co	28 Kennedy St. Bradford, Pa. 16701	----do	Jefferson.
Harbison Walker Refractories Co.	2 Gateway Center Pittsburgh, Pa. 15222	Pits	Cambria, Centre, Clearfield, Fayette, Somerset.
Ralph A. Veon, Inc	Darlington, Pa. 16115	Pit	Lawrence.
Kaolin: The Philadelphia Clay Co.	236 West North St. Carlisle, Pa. 17013	Pit	Cumberland.
Common clay and shale:			
Alwine Brick Co., subsidiary of Glen-Gery Corp.	New Oxford, Pa. 17350	Pit	Adams.
Bylite Corp	P.O. Box 1628 North End Station Wilkes-Barre, Pa. 18705	Pit	Luzerne.
Fenati Brick Co., Inc	New Castle, Pa. 16101	Pit	Lawrence.
Glen-Gery Corp	227 North 5th St. Reading, Pa. 19601	Pit	Berks, Northumberland, Union, York.
Hanley Co	28 Kennedy St. Bradford, Pa. 16701	Pit	McKean, Jefferson.
McAvoy Vitrified Brick Co.	Phoenixville, Pa. 19460	Pit	Chester.
McQuiston Coal Co.[6]	109 East Moody Ave. New Castle, Pa. 16101	Pit	Lawrence.
Milliken Brick Co., Inc	2100 Montier St. Pittsburgh, Pa. 15221	Pit	Allegheny.
The Robinson Clay Product Co.	65 West State St. Akron, Ohio 44309	Pit	Montgomery.
Coal:			
Anthracite:			
Blue Coal Corp.[4]	101 South Main St. Ashley, Pa. 18706	Underground	Luzerne.
Blue Coal Corp.[7]	----do	Culm bank	Do.
Blue Coal Corp.[8]	----do	Strip	Do.
Carbondale Coal Co., Inc.[4]	78 Cottage St. Carbondale, Pa. 18407	----do	Lackawanna.
Gangloff Brothers[4]	New Ringgold, Pa. 17960	Culm bank	Northumberland.
Glen-Nan Coal Co., Inc	St. Mary's and River Road Wilkes-Barre, Pa. 18702	Underground	Luzerne.
Greenwood Stripping Corp	1 Venice St. Nesquehoning, Pa. 18240	Strip	Carbon, Schuylkill.
Jeddo-Highland Coal Co.[8]	800 Exeter Ave. West Pittston, Pa. 18643	----do	Luzerne.
Jeddo-Highland Coal Co.[4]	----do	Culm bank	Do.
Kerris & Helfrick, Inc	Lehigh & Popular St. Mount Carmel, Pa. 18751	Strip	Columbia, Northumberland. Schuylkill.
Lehigh Valley Anthracite, Inc.	800 Exeter Ave. West Pittston, Pa. 18643	Culm bank	Carbon, Schuylkill, Luzerne.
Do	----do	Strip	Columbia, Luzerne, Schuylkill.
Pennsylvania Power & Light Co.	901 Hamilton St. Allentown, Pa. 18101	Dredge	Lancaster.
Ken Pollock, Inc.[4]	Route 11 Hunlock Creek, Pa. 18621	Culm bank	Luzerne.
Reading Anthracite Co	200 Mahantongo St. Pottsville, Pa. 17901	----do	Northumberland, Schuylkill.
Do	----do	Strip	Do.
Bituminous:			
Barnes & Tucker Co	357 Lancaster Ave. Haverford, Pa. 19041	Underground	Cambria, Indiana.
Bethlehem Mines Corp	701 East 3d St. Bethlehem, Pa. 18016	----do	Cambria, Washington.
Buckeye Coal Co	P.O. Box 900 Youngstown, Ohio 44501	----do	Greene.
Gateway Coal Co. for J & L Steel Corp.	Box 608 California, Pa. 15419	----do	Do.

See footnotes at end of table.

Table 17.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Coal—Continued			
Bituminous—Continued			
Harmar Coal Co.[4]	Box 500 Library, Pa. 15129	Underground	Allegheny.
Jones & Laughlin Steel Corp.	Box 608 California, Pa. 15419	do	Greene.
Mathies Coal Co	Box 500 Library, Pa. 15129	do	Washington.
Pittsburgh Coal Co.[4]	do	do	Do.
United States Steel Corp	525 Wm. Penn Pl. Pittsburgh, Pa. 15219	do	Greene, Washington.
Graphite (synthetic):			
Airco Speer Carbon Products, div. of Air Reduction Co., Inc.	Theresia St. St. Marys, Pa. 15857	Plant	Elk.
Chas. Pfizer & Co., Inc., MPM Division.	235 East 42d St. New York, N.Y. 10017	do	Northampton.
Stackpole Carbon Co	St. Marys, Pa. 15857	do	Elk.
Gypsum (calcined):			
United States Gypsum Co.[9]	101 South Wacker Dr. Chicago, Ill. 60606	do	Philadelphia.
Iron ore:			
Bethlehem Mines Corp.[10]	701 East 3d St. Bethlehem, Pa. 18016	Underground	Berks.
Bethlehem Mines Corp.[11]	do	do	Lebanon.
Iron oxide pigments:			
Crude:			
Allegheny Ludlum Steel Corp.	2000 Oliver Bldg. Pittsburgh, Pa. 15222	Plant	Allegheny.
Lanzendorfer Minerals Co	Twin Rocks, Pa. 15960	Pit	Cambria.
Finished:			
Minerals, Pigments & Metals Div., Chas. Pfizer & Co., Inc.	640 North 13th St. Easton, Pa. 18042	Plant	Northampton.
The Prince Manufacturing Co.	Bowmanstown, Pa. 18030	do	Carbon.
Reichard-Coulston, Inc	15 East 26th St. New York, N.Y. 10010	do	Northampton.
Lime:			
The J. E. Baker Co.[1]	P.O. Box 1189 York, Pa. 17405	do	York.
Mercer Lime & Stone Co	1640 Oliver Bldg. Pittsburgh, Pa. 15222	do	Butler.
National Gypsum Co.[1]	325 Delaware Ave. Buffalo, N.Y. 14202	do	Centre.
Standard Lime & Refrac. Co., Div. of Martin-Marietta Corp.[1]	2000 First National Bank Bldg. Baltimore, Md. 21203	do	Do.
Warner Company [1]	1721 Arch St. Philadelphia, Pa. 19103	do	Centre, Chester.
Mica (crude):			
Micalith Mining Co., Inc	P.O. Box 1671 Phoenix, Ariz. 85001	Pit	York.
Peat:			
Benton Peat	Benton, Pa. 17814	Bog	Columbia.
Blue Ridge Industries, Inc	Box 128, R.D. 2 White Haven, Pa. 18661	Bog	Luzerne.
D. M. Boyd Co	226 Francis St. New Wilmington, Pa. 16142	Bog	Lawrence.
Corry Peat Products Co	515 West Columbus Ave. Corry, Pa. 16407	Bog	Erie.
International Peat, Inc	R.D. 1 White Haven, Pa. 18661	Bog	Luzerne.
Lake Benton Peat Moss	1418 North Main St. Scranton, Pa. 18508	Bog	Lackwanna.
Pennsylvania Peat Moss, Inc	21st & Laurel Sts. Hazleton, Pa. 18201	Bog	Luzerne, Monroe.
Stillers Blue Ridge Peat Co	R.D. White Haven, Pa. 18661	Bog	Luzerne.
Wayne Peat Humus Co., Inc	P.O. Box 315 Gouldsboro, Pa. 18424	Bog	Wayne.
Welker's Greenhouse, Inc	New Castle, Pa. 16101	Bog	Lawrence.
Perlite (expanded):			
Armstrong Cork Co	Lancaster, Pa. 17603	Plant	Lancaster.
The Celotex Corp	1500 North Dale Mabry Tampa, Fla. 33607	do	Luzerne.
Insul-Fil Manufacturing Co	Box 325 Primos, Pa. 19018	do	Delaware.
Pennsylvania Perlite Corp	P.O. Box 2002 Lehigh Valley, Pa. 18001	do	Lehigh, York.
Perlite Manufacturing Co	P.O. Box 478 Carnegie, Pa. 15106	do	Allegheny.

See footnotes at end of table.

Table 17.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Petroleum refineries:			
Atlantic Richfield Co	260 South Broad St. Philadelphia, Pa. 19102	Plant	Philadelphia.
BP Oil Corp	600 Fifth Ave. New York, N.Y. 10001	do	Delaware.
Gulf Oil Corp	P.O. Box 7408 Philadelphia, Pa. 19101	do	Erie.
Kendall Refining Co., Div. of of Witco Chemical Co.	Bradford, Pa. 16701	do	McKean.
Pennsylvania Refining Co	Karns City, Pa. 16041	do	Butler.
Pennzoil United, Inc	Oil City, Pa. 16301	do	Venango.
Quaker State Oil Refining Corp	Farmers Valley, Pa. 16749	do	McKean, Venango.
Sun Oil Company	1608 Walnut St. Philadelphia, Pa. 19101	do	Do.
United Refining Co	Warren, Pa. 16365	do	Warren.
Valvoline Oil Co., Div. of Ashland Oil and Refining Co.	Freedom, Pa. 15042	do	Beaver.
Wolf's Head Oil Refining Co., Inc.	Reno, Pa. 16343	do	Venango.
Sand and gravel:			
Davison Sand & Gravel Co	34th Ave. & 4th St. New Kensington, Pa. 15068	Dredge	Westmoreland.
Erie Sand Steamship Co	Erie, Pa. 16500	do	Erie.
Glacial Sand & Gravel Co	P.O. Box 10 Kittanning, Pa. 16201	Pit	Armstrong.
Hunlock Sand & Gravel Co	Box 275-A R.D. 1 Hunlock Creek, Pa. 18621	Pit & plant	Luzerne.
Lycoming Silica Sand Co	401 Broad St., Box 159 Montoursville, Pa. 17754	Pit	Lycoming.
Mahoning Valley Sand Co	Box 1236 New Castle, Pa. 16102	Pit & plant	Lawrence.
Manorville Sand Co	Box 251 Manorville, Pa. 16238	Pit	Armstrong.
Pennsylvania Glass Sand Corp	Berkeley Springs, W. Va. 25411	Pit	Huntingdon, Mifflin, Venango.
Pennsy Supply, Inc	1001 Paxton St. Harrisburg, Pa. 17104	Pit	Perry.
Seidle Sand & Gravel, Inc	R.D. 4 Mercer, Pa. 16137	Pit	Mercer.
State Aggregates, Inc	635 Lucknow Lane Harrisburg, Pa. 17110	Pit	Bradford.
Warner Company	1721 Arch St. Philadelphia, Pa. 19103	Pit	Bucks.
Smelters:			
The New Jersey Zinc Co	Palmerton, Pa. 18071	Plant	Carbon.
St. Joe Minerals Corp	Josephtown, Pa. 15061	do	Beaver.
Stone:			
Limestone and dolomite—crushed:			
Applachian Stone Div., Martin-Marietta Corp.	Box 120 Mercersburg, Pa. 17236	Quarry	Centre, Chester, Fayette, Franklin.
Bethlehem Mines Corp	701 East 3d St. Bethlehem, Pa. 18016	do	Adams.
Bethlehem Mines Corp	do	do	Mifflin, Montgomery, Northampton.
Bradford Hills Quarries, Inc	Box 231 Easton, Pa. 18042	do	Chester, Lancaster, Perry.
G. & W. H. Corson, Inc.[12]	Plymouth Meeting, Pa. 19462	do	Montgomery.
Eureka Stone Quarry, Inc	Lower State & Pickertown Rds. Eureka, Pa. 18914	do	Bucks.
Eastern Industries, Inc	Box 188 Wescosville, Pa. 18090	do	Berks, Lehigh.
Lycoming Silica Sand Co	P.O. Box 159 Montoursville. Pa. 17754	do	Columbia, Lycoming, Montour.
National Gypsum Co	325 Delaware Ave. Buffalo, N.Y. 14202	do	Berks, Centre, York.
New Enterprise Stone & Lime.	New Enterprise, Pa. 16664	do	Bedford, Blair, Franklin, Huntingdon.
United States Steel Corp	Hillsville, Pa. 16132	do	Lawrence.
Miscellaneous—crushed & broken:			
Gill Quarries, Inc	P.O. Box 187 Fairview Village, Pa. 19434	do	Montgomery.
M & M Stone Co	Harleysville, Pa. 19438	do	Do.
Miscellaneous—dimension:			
F. Cantono & Sons	454 Germantown Pike Lafayette Hill, Pa. 19444	do	Delaware.

See footnotes at end of table.

Table 17.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Sandstone and quartzite—crushed:			
American Asphalt Paving Co.	Box 95, R.D. 5 Shavertown, Pa. 18700	Quarry	Luzerne.
Bear Gap Stone Inc	R.D. 1 Elysburg, Pa. 17824	do	Northumberland.
Coolbaugh Sand & Stone, Inc.	32 Railroad Ave. Scranton, Pa. 18505	do	Luzerne.
Detwilers Industries, Inc., subsidiary of New Enterprise Stone & Lime Co., Inc.	New Enterprise, Pa. 16664	do	Bedford, Somerset.
Eidemiller Enterprises, Inc.	Greensburg, Pa. 15601	do	Westmoreland.
Faylor Lime & Stone Co	Winfield, Pa. 17889	do	Dauphin, Northampton.
Keeler Supply Co., Inc	Box 12 Clifford, Pa. 18413	do	Susquehanna.
Latrobe Construction Co	P.O. Box 150 Latrobe, Pa. 15650	Underground	Westmoreland.
No. 1 Contracting Corp. of Delaware.	Box 460 Pittston, Pa. 18640	Quarry	Northampton, Schuylkill.
Summit Quarries, Div. of J. Robert Bazley, Inc.	P.O. Box 298 Pottsville, Pa. 17901	do	Schyulkill.
Sandstone and quartzite—dimension:			
Caln Building Stone Corp	R.D. 1 Zion Grove, Pa. 17985	do	Chester.
Delaware Quarries	Lumberville, Pa. 18933	do	Bucks.
Firestone Products Co., Inc.	300 Willow Grove Ave. Glenside, Pa. 19038	do	Montgomery.
Media Quarry Co	131 East 2d St. Media, Pa. 19063	do	Delaware.
Valley Forge Building Stone.	P.O. Box 195 Morgantown, Pa. 19543	do	Chester.
Slate—crushed:			
Pennsylvania Light-weight Aggregate, Inc.	Bangor, Pa. 18013	do	Northampton.
Slate—dimension:			
Capitol Slate Co., Inc	P.O. Box 281 East Bangor, Pa. 18040	do	Do.
Anthony Dally & Sons, Inc.	Robinson Ave. Pen Argyl, Pa. 18072	do	Do.
Doney Slate Co	Pen Argyl, Pa. 18072	do	Do.
Emerald Slate Corp	Alpha Road Wind Gap, Pa. 18091	do	Do.
North Bangor Slate Co	Bangor, Pa. 18013	do	Do.
Penn Big Bed Slate Co., Inc.	446 Main St. Slatington, Pa. 18080	do	Lehigh.
Stephens-Jackson Co	Main St. & Schanck Ave. Pen Argyl, Pa. 18072	do	Northampton.
D. Stoddard & Sons, Inc	Bangor, Pa. 18013	do	Do.
Traprock (basalt)—crushed and broken:			
Bucks County Crushed Stone, Inc.	Ottsville, Pa. 18942	do	Bucks.
V. Di Francesco & Sons	17 Mifflin Ave. Havertown, Pa. 19083	do	Chester.
Do	do	do	Delaware.
The General Crushed Stone Co.	712 Drake Bldg. Easton, Pa. 18042	do	Bucks, Delaware.
Vernon B. Horn	R.D. Chalfont, Pa. 18914	do	Bucks.
Kibblehouse Quarries, Inc.	Perkiomenville, Pa. 18074	do	Montgomery.
Montgomery Stone Co., Inc.[13]	Montgomeryville, Pa. 18936	do	Do.
Pottstown Trap Rock Quarries, Inc.	R.D. 1 Douglasville, Pa. 19518	do	Berks, Montgomery.
Tohickon Quarry Co	Quakertown, Pa. 18951	do	Bucks.
Warner Company	1721 Arch St. Philadelphia, Pa. 19103	do	Berks.
Traprock (basalt)—dimension:			
Coopersburg Granite Co	Coopersburg, Pa. 18036	do	Bucks.
Granite—crushed:			
Mignatti Construction Co., Inc.	2310 Terwood Ave. Bethayres, Pa. 19006	do	Montgomery.
Granite—dimension:			
Carl Galantino, Inc	42 Hirst Ave. East Lansdowne, Pa. 19050.	do	Delaware.

See footnotes at end of table.

Table 17.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Sulfur:			
Atlantic Richfield Co	3144 Passyunk Ave. Philadelphia, Pa. 19145	Plant	Philadelphia.
Gulf Oil Corp	P.O. Box 7408 Philadelphia, Pa. 19101	----do	Do.
BP Oil Corp., subsidiary of British Petroleum Corp. Ltd.	P.O. Box 428 Marcus Hook, Pa. 19061	----do	Delaware.
Sun Oil Co	1608 Walnut St. Philadelphia, Pa. 19103	----do	Do.
Tripoli (rottenstone):			
Keystone Filler & Manufacturing Co.	Muncy, Pa. 17756	Pit	Lycoming.
Penn Paint & Filler Co	Antes Fort, Pa. 17720	Pit	Do.
Vermiculite (exfoliated):			
Hyzer & Lewellen	P.O. Box 155 Southampton, Pa. 18966	Plant	Bucks.
W. R. Grace & Company, Zonolite Div.	62 Whittemore Ave. Cambridge, Mass. 02140	----do	Lawrence.

[1] Also limestone.
[2] Also limestone and shale.
[3] Also limestone and clay.
[4] 2 operations.
[5] Also limestone and sand and gravel.
[6] Also fire clay.
[7] 3 operations.
[8] 4 operations.
[9] Also expanded perlite.
[10] Also byproduct cobalt and pyrites.
[11] Also byproduct gold, silver, copper, cobalt, and pyrites.
[12] Also lime.
[13] Also dimension.

Arthur A. Socolow, State Geologist

EXPLANATION

- Trs — Sandstones and Shales — Triassic
- Oco — Cocalico Formation — Ordovician
- Om — Myerstown Formation — Ordovician
- Oan — Annville Formation — Ordovician
- Ob — Upper Beekmantown Group — Ordovician

Geologic contact, dashed where approximate, dotted where inferred or covered

Anticline in Epler Formation, concealed below Cocalico Formation where short dashes are shown

Overturned anticline

Overturned syncline

Fault, relative movement indicated by U (up) and D (down)

Thrust fault, barbs on side of upper plate

Strike and dip of beds known to be right side up

Strike and dip of beds where it is not known which side is up

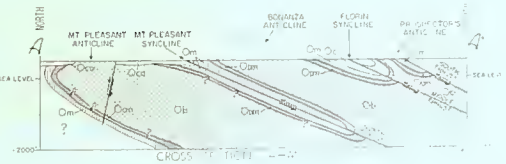
Strike and dip of overturned beds

Generalized strike and dip of bedding

Strike and dip of foliation

Strike and dip of cleavage

(A) Location of sample and/or quarry



GEOLOGIC MAP OF THE MOUNT JOY AREA, LANCASTER COUNTY, PENNSYLVANIA

by
B.J. O'Neill, Jr.

1975

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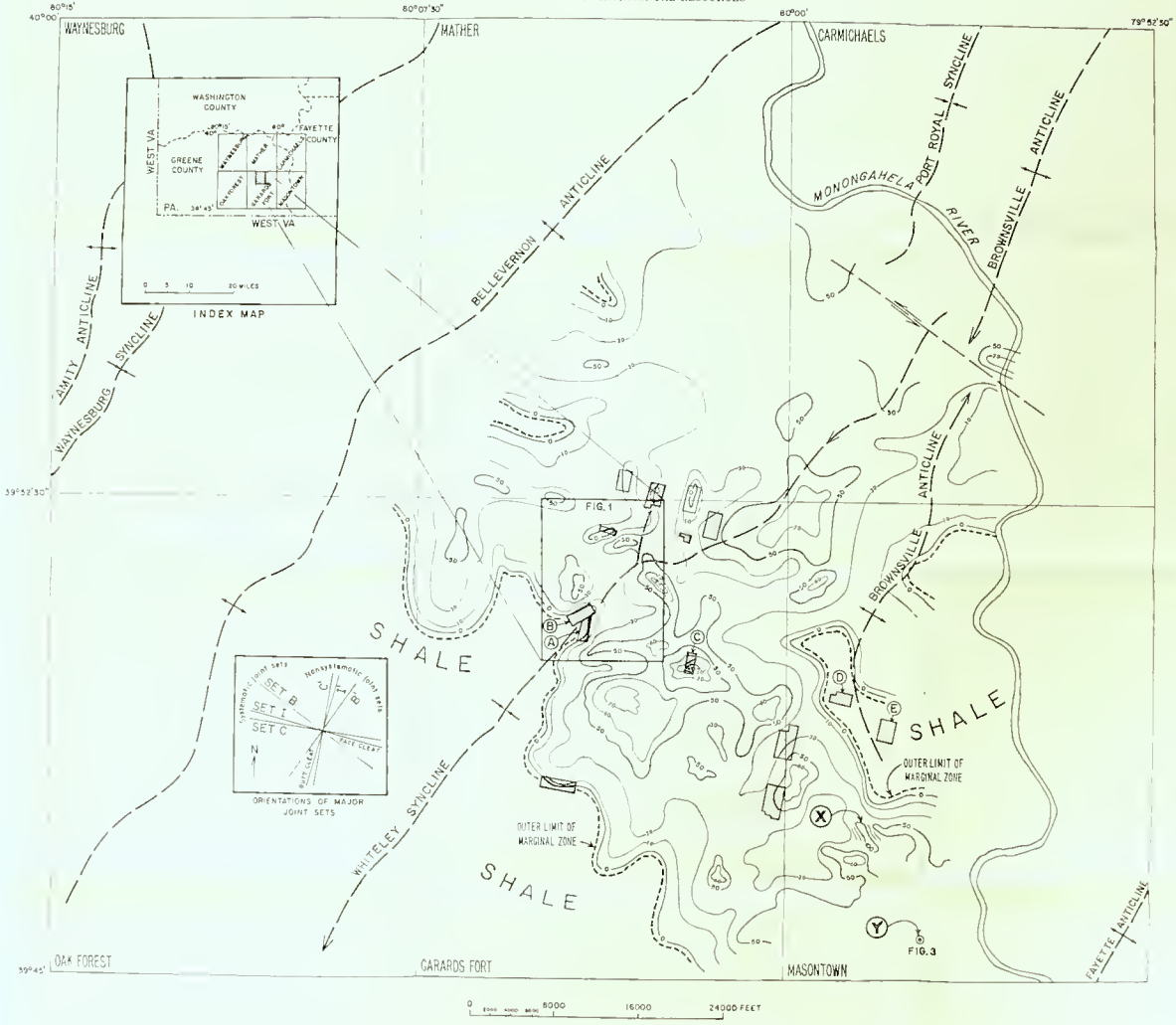
TOPOGRAPHIC AND GEOLOGIC SURVEY
Arthur A. Socolow, Director

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES

INFORMATION CIRCULAR 75, PLATE 1



EXPLANATION

Isopachs, in feet, of Pittsburgh sandstone (as used by Piper, 1933)

Areas within the sandstone belt where lenses of Pittsburgh sandstone (as used by Piper, 1933) are in erosional contact with the underlying Pittsburgh coal

Fault zone, showing direction of relative movement

C — Frequent
E — Very few
Representative mine area where roof falls were encountered in mining

X Y — Labeled area discussed in text

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by BION H. KENT

1974